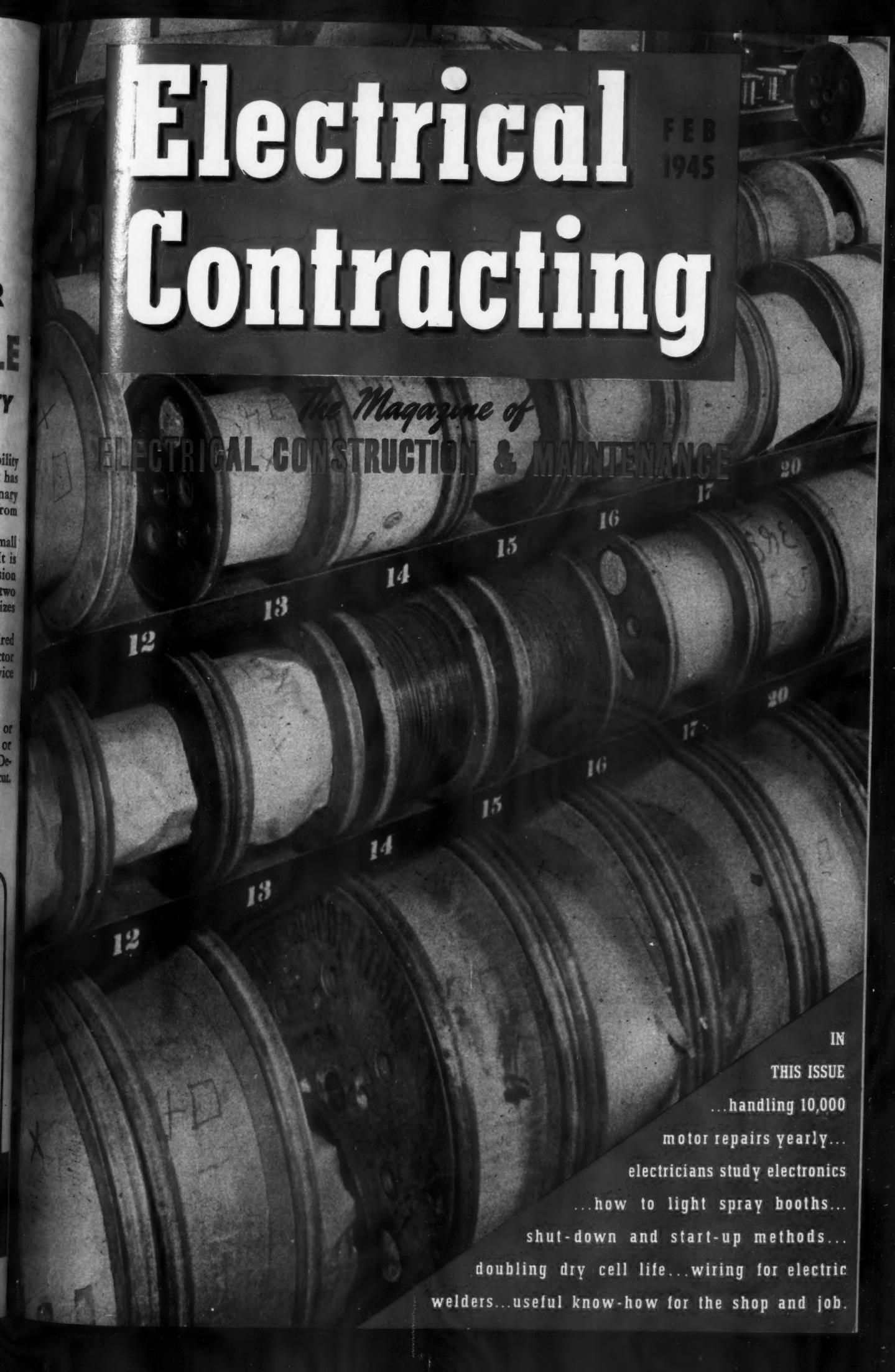
Electrical Contracting

FEB 1945

the Magazine of

ELECTRICAL CONSTRUCTION & MAINTENANCE



IN THIS ISSUE

...handling 10,000 motor repairs yearly... electricians study electronics ...how to light spray booths... shut-down and start-up methods... doubling dry cell life...wiring for electric welders...useful know-how for the shop and job.

FLAMENOL *Showed No Aging*

THIS FLAMENOL CABLE, after six years' exposure to weather, without covering, is as good as new. Note the glossy, uncracked surface.
THIS OIL-BASE, RUBBER-INSULATED cable, exposed to identical conditions over the same period, is dull and badly cracked.
THIS MINERAL-BASE, RUBBER-INSULATED cable, after the same exposure, shows the same dullness and cracking as the oil-base rubber insulation.

IN THIS SIX-YEAR TEST UNDER FLORIDA'S SUN

Back in 1937, a large railroad company operating in the South, where climate is particularly unkind to cable insulations, decided to test the stamina of various types of insulation. Two of the samples tested were the usual rubber-insulated types; the third was Flamenol. None was protected by braid or other covering, so that insulation was exposed directly to sun and weather.

In 1943, after six years of continuous exposure, the three samples were taken down, and examined. The dramatically conclusive results are shown in the photographs above. Only Flamenol had stayed young!

FLAMENOL RESISTS ACID, ALKALI, OIL, AND WATER

Before the war, millions of feet of Flamenol cable had already been installed in factories, oil refineries, mines and railroads; places where its ability to resist most solvents and heat made it a "must." In the future, this proved-performance cable will find even wider fields of application in reducing maintenance costs and minimizing shut-downs due to insulation failure.

Note, at the right, Flamenol's operating, installation, and maintenance advantages. For complete information, ask our local office, or write to *General Electric Company, Schenectady 5, N. Y.*

11 OUTSTANDING ADVANTAGES OF *FLAMENOL*

1. **FLAME RESISTANCE**—*will not support combustion.*
2. **CORROSION RESISTANCE**—*immune to action of oils, acids and alkalis.*
3. **SUPER-AGING**—*will not oxidize, therefore highly resistant to sunlight and weathering.*
4. **EXCELLENT PHYSICAL PROPERTIES**—*minimum tensile strength, 1,500 lb per sq in.; minimum elongation, 100 per cent.*
5. **CONSTANT DIELECTRIC STRENGTH**—*retained at about 720 volts per mil under severe operating conditions.*
6. **SMALL DIAMETER**—*saves space, and speeds wiring.*
7. **SMOOTH SURFACE**—*facilitates pulling through conduit.*
8. **VARIETY OF COLORS**—*simplifies circuit tracing.*
9. **FREE STRIPPING**—*steps up installation, avoids weakening nicks on conductors.*
10. **WIDE RANGE OF CONSTRUCTIONS**—*aids selection for special applications.*
11. **SELF-PROTECTING FINISH**—*eliminates need for braid covering, saves space and weight.*

Buy all the BONDS you can—and keep all you buy

FLAMENOL INSULATED CABLE

GENERAL ELECTRIC

502-47-1200

"A FIRST CLASS INSTALLATION", *say electricians*

(*and they also say,* "SO EASY TO PUT IN")

Arc-quenching construction in 2, 3 and 4 Pole, 30, 60 and 100 Ampere Safety Switches.

SKETCHED above is the switch block from a Murray Single Throw, Fusible, Type D, Safety Switch. In the circle is the outstanding feature — the double break blade and arc quenching chamber. Each blade is provided with a double break — the arc is broken into two parts. The burning is greatly reduced by this feature. Whatever arc is formed at each of the two breaks is drawn into a narrow slot in the mounting base where it is lengthened-out and cooled — the effects co-acting to quench the arc almost instantly. This arc-quenching construction coupled with those Murray Switch characteristics as ample wiring room, properly placed knockouts, good-looking cabinets, assure the electrician the satisfaction that comes from a first-class installation. Metropolitan Device Corporation, Brooklyn, New York.

Write for the facts — no obligation!

Murray

SAFETY SWITCHES

THERE ARE MURRAY JOBBERS EVERYWHERE

Keep On

BUYING WAR BONDS AND STAMPS

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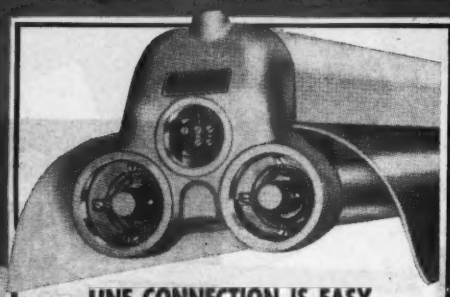
MARVEL OF SIMPLICITY

Skillful Design Cuts Costs in New, Exclusive . . .

Approved for All Class I, Groups C and D Class II, Groups E, F and G Hazardous Locations

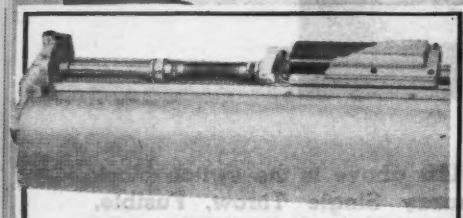


LINE CONNECTION IS EASY

End view with explosion-proof screw covers removed. Connecting block in upper hole simplifies installation. No other connections are made on the job. Lower holes show easily accessible starters, which can be replaced without removing lamps.

RE-LAMP IN A JIFFY

Two 40-watt, 48-inch T-12 lamps, supported by wire cradles in tightly-sealed explosion-proof Pyrex tubes. Cradles seat lamps easily at far end. Special tool furnished for engaging electrodes in handling lamps.



BALLAST QUICKLY ACCESSIBLE

Mounted in explosion-proof housing at center of unit, under outer dust cover. Easily reached when replacement is necessary. Flexible coupling relieves any possible strain on Pyrex tubes. Highly efficient, baked white enamel reflectors easily removed for washing.

APPLETON *Explosion-Proof* FLUORESCENT FIXTURE

Simple, low-cost installation and quick, easy maintenance are part of the design of the new Appleton Explosion-Proof Fluorescent Lighting Fixture. They're *built-in!*

Economy of man-hours makes doubly attractive the many advantages of fluorescent lighting in hazardous locations working night and day in war production. Allowing for the fact that all wiring must be tightly enclosed to guard against explosion, every operation in installation and maintenance is as simple as with ordinary fluorescent equipment. Additional maintenance cost is no factor.

Skillful Appleton engineering, so marked in this latest Appleton achievement, is common to all Appleton products—"Unilets," both regular and explosion-proof; lighting fixtures; conduit fittings; outlet and switch boxes. All of the thousands of types are carefully designed to install easily, to stand up on the job, to give maximum low-cost service.

Look carefully at the illustrations above, they'll tell you, *plainly,* why Appleton Explosion-Proof Fluorescent Lighting Fixtures should be in every hazardous location in your community—why it's wise, *on every job,* to specify Appleton equipment—"STANDARD FOR BETTER WIRING!"

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CONDUIT FITTINGS • OUTLETS AND SWITCH BOXES • EXPLOSION-PROOF FITTINGS • REELITES

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A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering, installation, repairing, maintenance and management, in the field of electrical construction and maintenance.

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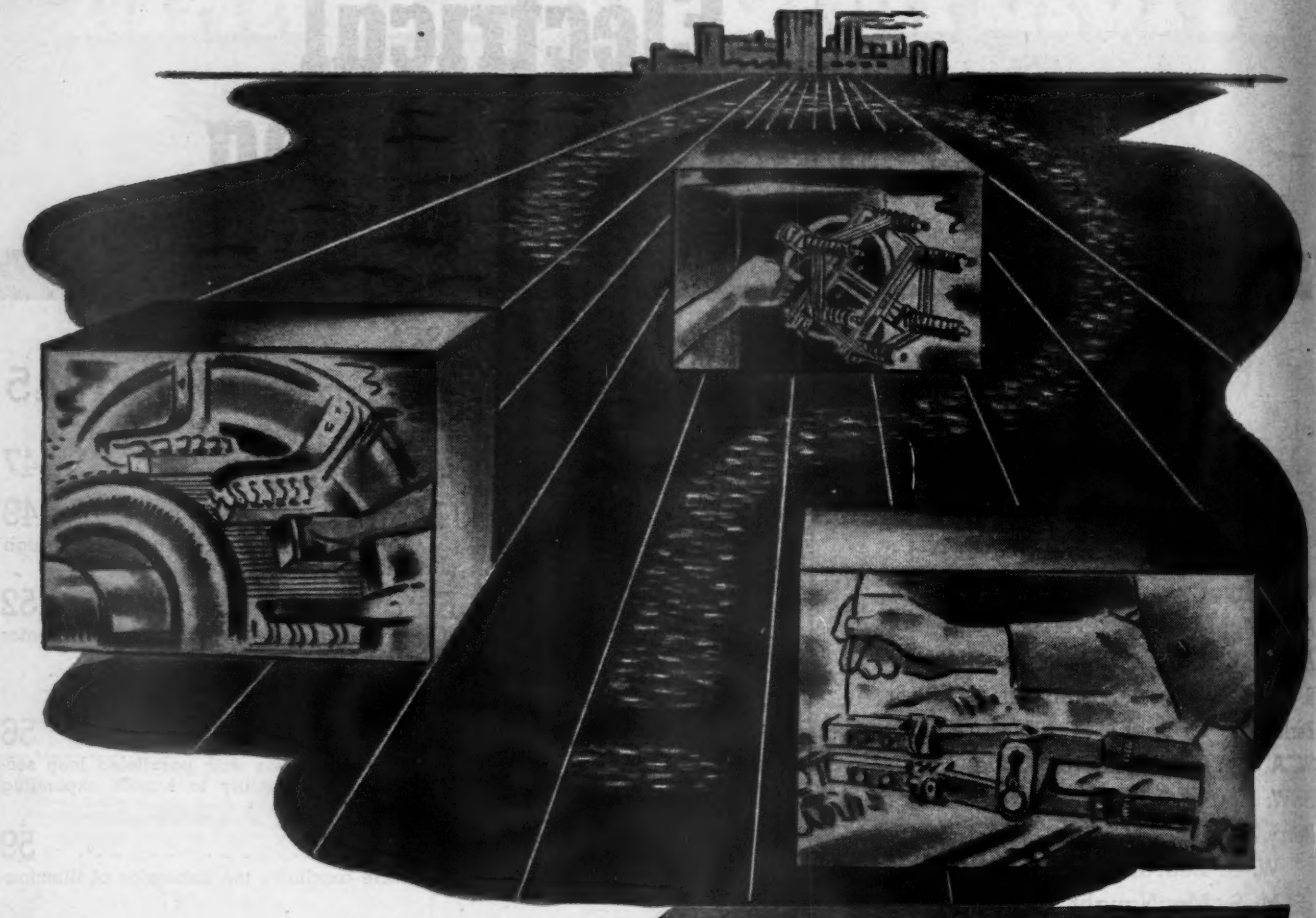
HOW TO KEEP WAR-WEARY MOTORS IN SERVICE!



Use *Modern* IDEAL Motor Maintenance and Repair Equipment to Restore Motor and Generator Efficiency

. . . INEXPENSIVELY!

Here is the way to restore motors and generators, war-weary from their years of round-the-clock service, to tip top condition, *while on the job*. IDEAL's complete line of Motor Maintenance Equipment quickly reconditions over-worked motors and generators *without taking them out of service.* The IDEAL line of money-saving equipment includes ***100 products*** serving more than ***40,000 customers*** through ***200 IDEAL Service Engineers.*** Stocks carried at the plant, in warehouses and with wholesalers in all principal cities.

Ask for the 88-page IDEAL Handbook giving complete information.

IDEAL Sycamore

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1041 Park Avenue Sycamore, Illinois

Over 100 Products to Help Electricity Serve Better

IDEAL
MOTOR MAINTENANCE
EQUIPMENT

IDEAL RESURFACERS
For regular use. Keep Commutators and Slip Rings at original smoothness and efficiency without taking motors out of service.

IDEAL PRECISION GRINDERS
Use to restore surfaces that are badly scored and out-of-round. Mount on motor frame—no dismantling necessary.

IDEAL MICA UNDERCUTTERS
Undercut hardest mica without removing armature.

Send for FREE Motor Maintenance Handbook

PROMPT DELIVERY

Meet Mr. Quality

ONE LOOK AT Bill Seebode — 50 year man at Allis-Chalmers Norwood Works — tells you that he sleeps well nights.

One reason is that he and hundreds of his fellow craftsmen at Allis-Chalmers have won *and are keeping* the confidence of engineers and operating men throughout American Industry.

That means a lot to veterans like Bill who've made a career of building great motors.

Bill's a stator-winder, as you can see—a living example of the truism that *men* make motors.

No machine known can assemble the maze of wiring and insulation that goes into a stator with his skill and care. No machine can fully test how *well* he's done his job.

There's only one test... wait 5, 10, 15 years and *see.*

And that's the test that has proved Allis-Chalmers motors are *great* motors. That's why you hear it said so often: *"You can depend on Allis-Chalmers Motors!"*

Yes, hundreds of Allis-Chalmers men—*quality* men like Bill Seebode — know they have a big personal stake in every Allis-Chalmers motor. When they build a great motor for you, they're making a friend... and they know that's something no company and its workers can have too many of. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

• • •

♪ *Tune in the Boston Symphony, Blue Network, Saturday at 8:30 pm, EWT.*

A 1729

YOU CAN DEPEND ON ALLIS-CHALMERS MOTORS

Talk about BEAUTY!

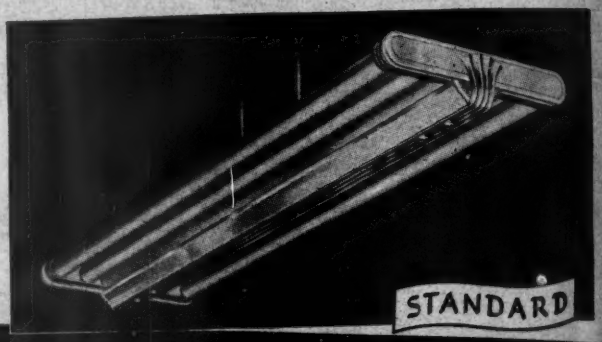
Take a look at these NEW SMITHCRAFT Commercial Units

"Far ahead of anything in the field" is what the authorities say unhesitatingly after they have looked over this new line.

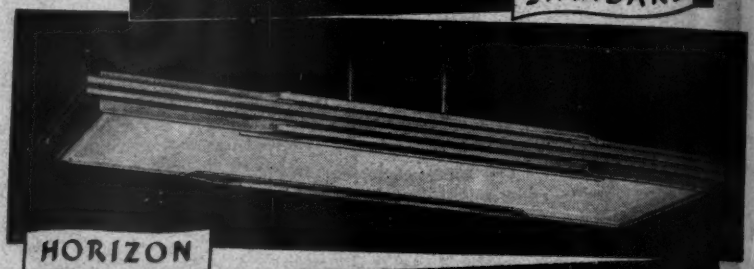
These beautiful SMITHCRAFT Commercial Fixtures really are n-e-w . . . in conception, design and various maintenance angles. They are positively not "just another" embellishment of pre-war styles and thoughts. Finer architectural appearance . . . sturdy . . . and with exclusive definite features which insure maximum light output and lowest possible installation and maintenance costs.

EASE OF INSTALLATION

Completely equipped for either surface or pendant mounting, individually or in continuous rows, SMITHCRAFT FIXTURES have that balanced construction and maximum utilization of steel which make them light to handle and easy to install. Your attention is especially invited to the new exclusive Non-Turn Stem Lock which converts pendant mounting into a *one-man* job . . . and what a saving in time!

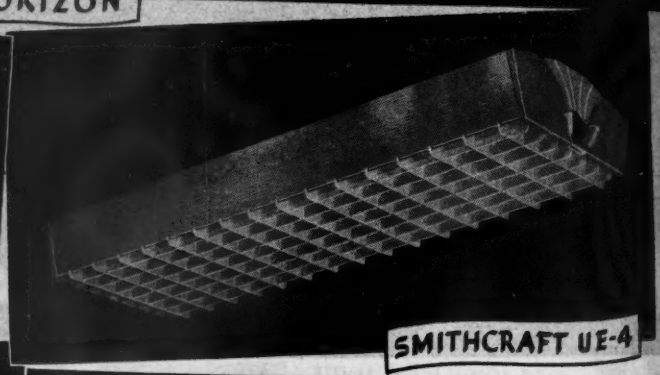


STANDARD

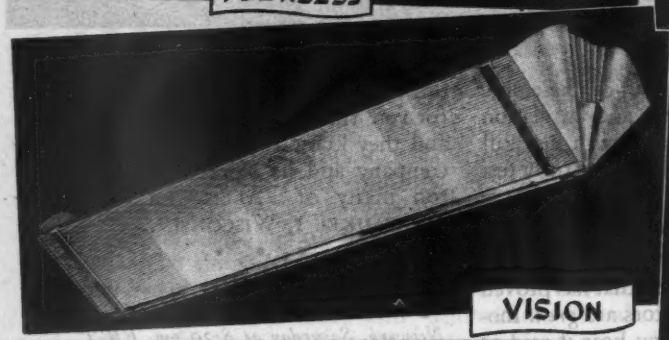


HORIZON

PEERLESS



SMITHCRAFT UE-4



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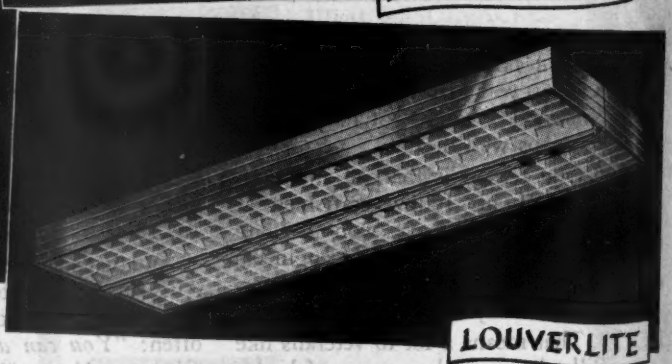
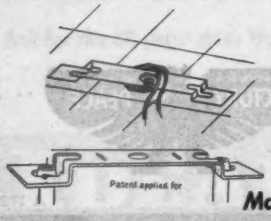
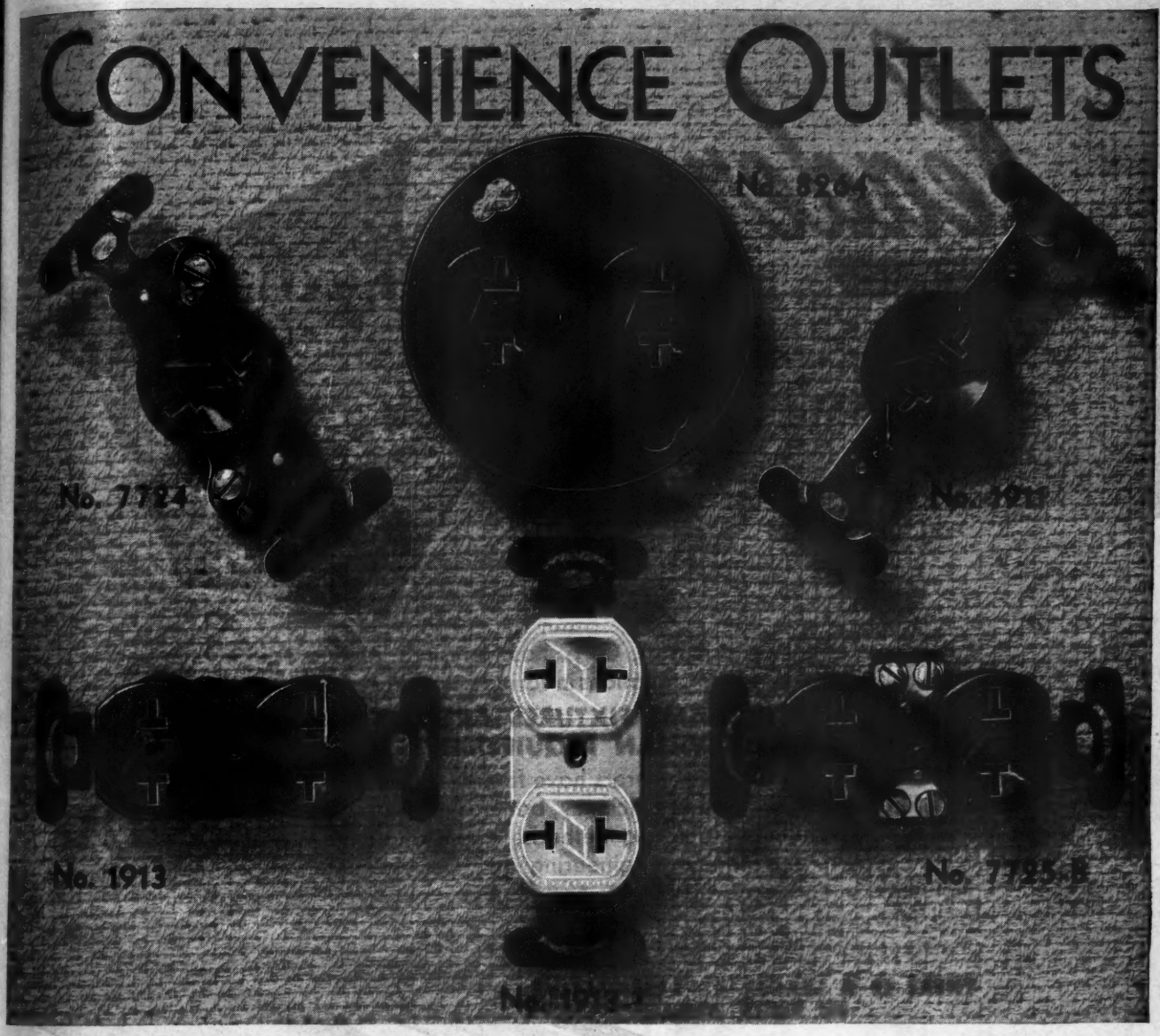


LOUVERLITE



Exclusive with
SMITHCRAFT
NON-TURN STEM LOCK
Makes hanging a one-man job
Slips on • Locks tight
No threads • No bolts • No Tools

Smithcraft
LIGHTING DIVISION
Chelsea, Mass.



ARROW all-purpose numbers for flush or surface work

These popular types of Convenience Outlets are available in brown and white "Ivorylite" plastics, as good in looks as they are good in quality. T-slot, with double side-contacts, self-adjusting.

No. 7724—Single, top-wired, Bakelite; No. 8264—Duplex, with 3¼" outlet box cover (4" also supplied); No. 1911—Single, side-wired, Bakelite; No. 1913—Duplex, side-wired, Bakelight; No. 1913-I—Duplex, side-wired, Ivorylight; No 7725-B—Duplex (4 Screws) top-wired, Bakelite. Just the group you need for carrying-on.

ARROW ELECTRIC DIVISION

DISTRIBUTED THROUGH ELECTRICAL WHOLESALERS

THE ARROW-HART & HEGEMAN ELECTRIC COMPANY, HARTFORD, CONN., U.S.A.

Leader STANDARD FIXTURES

Meet the RIGID SPECIFICATIONS of both the Army and Navy

For years Leader Electric Mfg. Corp. has furnished lighting equipment to both Services for installations in varied military establishments.

EXACTLY THE SAME FIXTURES ARE AVAILABLE FOR CIVILIAN REQUIREMENTS*

Defense plants and manufacturers have found Leader Electric Products foremost in Design and Efficiency, both in installation and maintenance. Careful manufacturing methods, low installation and maintenance cost, plus careful Engineering and Design make Leader Fixtures a quality unit which meets Army and Navy specifications and "tops" in the fluorescent lighting field.

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POST WAR LIGHTING *Now*

Sold only through the better Electrical Wholesalers

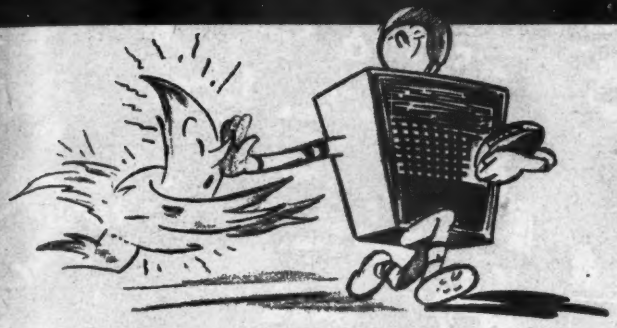
LEADER ELECTRIC MFG. CORP.

6127 N. BROADWAY, CHICAGO 40, ILLINOIS

HERE'S ALLIS-CHALMERS' GREAT NEW V-Belt Team!

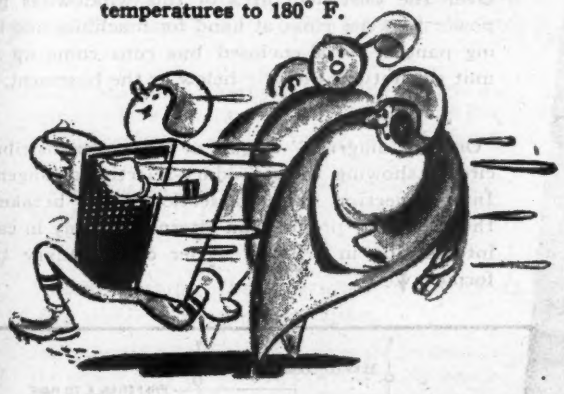
ALLIS-CHALMERS recommendations for belt selections are unbiased . . . because Texrope's V-belt lineup is *complete*. And as inventor of the multiple V-belt drive, A-C offers sound engineering help . . . backed by the world's longest experience in giving industry money-saving drives.

♪ *Tune in-Boston Symphony, Blue Network, Sat. Eves.*



1 **HEAT-RESISTING SUPER-7** has ability to withstand high ambient built right into it. Standard belt, it can operate in temperatures to 180° F.

2 **OIL-RESISTING SUPER-7** is right for drives where fairly bad oil conditions prevail. Neoprene-covered, it resists oil spray and grease.



3 **OIL-PROOF SUPER-7,** is solid Neoprene—a synthetic unaffected by most rubber attacking liquids. Recommended for *extreme* oil conditions.

4 **STATIC-RESISTING SUPER-7** *conducts* static charge to machine for grounding charge. This safety belt is applied where explosion danger exists.

5 **SUPER-7-STEEL** employs endless steel cables to provide greater strength, reduce belt stretch. It is ideal for driving extra-heavy loads.

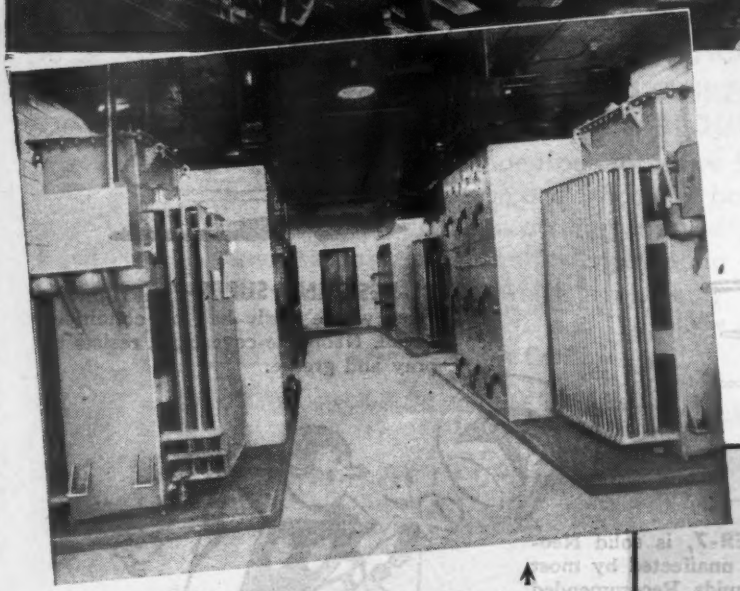
A 1732

IT PAYS TO MAKE ALLIS-CHALMERS YOUR V-BELT DRIVE HEADQUARTERS

Texrope Super-7 V-Belts result from the cooperative research of two great companies—Allis-Chalmers and B. F. Goodrich—and are sold exclusively by A-C.

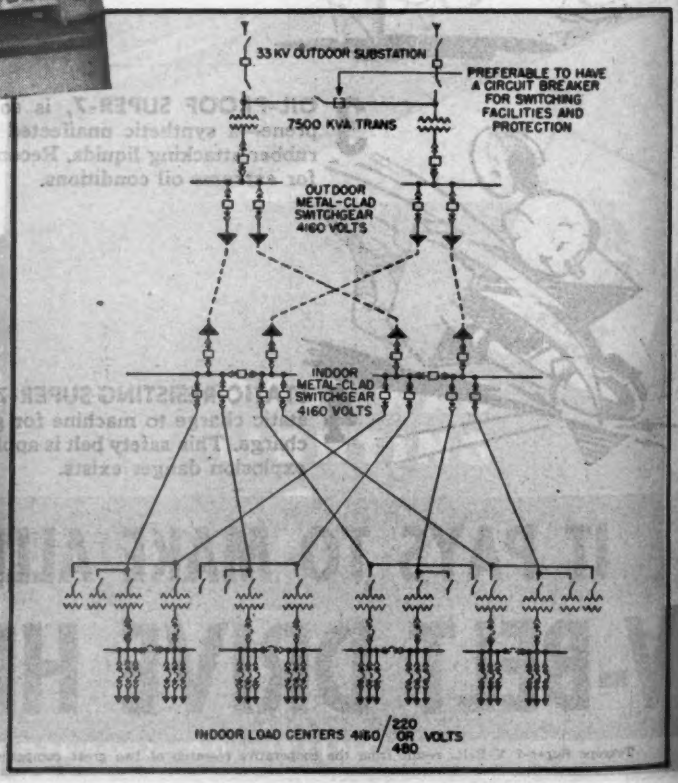
NO "FREEZE" ON

Over the vast floor area of this windowless plant, power taps are close at hand for machines and lighting panels. Metal-enclosed bus runs come up from unit substations directly below in the basement.



A group of G-E load-center unit substations, showing high-voltage lines entering in interlocked-armor cable and the outgoing low-voltage metal-enclosed bus runs. Each load-center unit has two incoming lines.

"One-line diagram" of part of the power distribution circuit, showing the secondary-selective arrangement. Interconnection through sectionalizing breakers in the secondary provides an alternate supply in case of interruption in primary feeder or secondary transformer.


33 KV OUTDOOR SUBSTATION
PREFERABLE TO HAVE A CIRCUIT BREAKER FOR SWITCHING FACILITIES AND PROTECTION
7500 KVA TRANS
OUTDOOR METAL-CLAD SWITCHGEAR 4160 VOLTS
INDOOR METAL-CLAD SWITCHGEAR 4160 VOLTS
INDOOR LOAD CENTERS 4160/220 OR 480 VOLTS

GE

LOAD-CENTER

Power Distribution Systems

MACHINE LOCATION

at a plant with a load-center power system

Output has stayed high in this aircraft-engine plant, in spite of work changeovers that require relocation of many machines. In one three-month period, more than 2000 machines were shifted, but these machines never stood idle for lack of electric energy.

Why was full-voltage power so quickly available for every machine, no matter where located? Why has the plant management such complete *freedom* in planning tomorrow's work flow and machine location?

First, because when the plant was built, ***power flow was put on a par with production flow.***

Such advanced features of plant design as windowless, air-conditioned construction could be adopted without misgivings—because the secondary-selective distribution system gives unusual protection to power continuity. It helps make a plant-wide blackout virtually impossible.

Second, because ***the distribution system is of the modern load-center type.***

Individual G-E unit substations are located in the basement, for the most part directly below the load areas they serve. Primary power is distributed to these units at 4160 volts, each load-center substation having two incoming lines. Secondary circuits, each with its individual breaker, consist of short, metal-enclosed bus runs, passing up through the floor and above the work area, with power taps of Flamenol† cable to the machines.

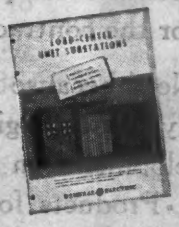
Third, because metal-clad switchgear and unit substations were selected for the job.

A transformer section using Pyranol*, which is non-burning, permits G-E unit substations to be installed without vaults wherever the loads require them. G-E switchgear assures *adequate* interrupting capacity. Increased loads requiring more transformer capacity can be supplied with additional easily installed units.

Before you settle on your plans for plant reconversion with respect to power supply, why not review the experience of plants that have adopted *load-center distribution?* G-E application engineers will be glad to give you facts and figures for immediate or postwar consideration. *General Electric Company, Schenectady 5, N. Y.*

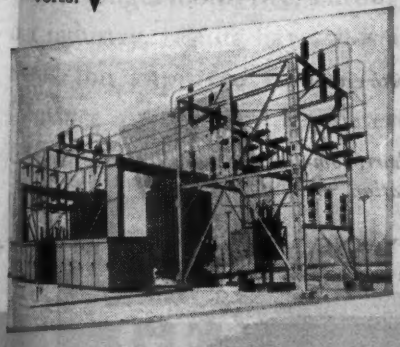
†*Reg. U.S. Pat. Off.*

**Trade-mark for General Electric's nonoxidizing, insulating and cooling liquid that will not burn*

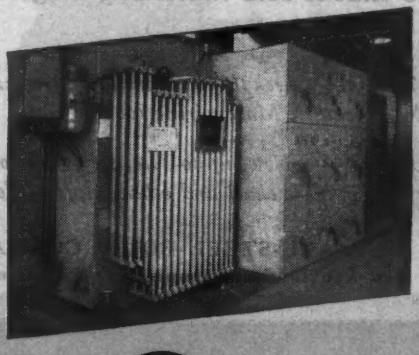


Write for this new booklet—"Load-center Unit Substations" (GEA-3592) gives valuable information on planning a fully modern power system, shows installation in many plants.

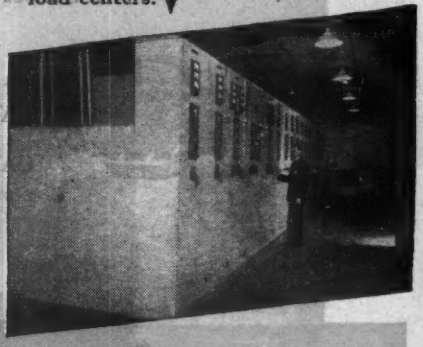
At this outdoor substation, two G-E 7500-kva transformers step down the 33-kv incoming energy to 4160 volts.



Close-up of G-E unit substation showing Pyranol transformer and metal-enclosed, drawout air circuit breakers.



Indoor vertical-lift metal-clad switchgear protects incoming lines and distribution feeders to the load centers.



GENERAL ELECTRIC

BUY WAR BONDS

302-35

The Raco • All-Steel • Line rates No. 1 with electrical contractors throughout America because it's a "quality" line—it's clean, attractively packaged, and trade-marked—it identifies good workmanship, better materials! Accepted by architects and builders, it helps win approval for the contractor's work.

Raco rates No. 1 because it's a dependable line, a complete line. More than 31 years of engineering have kept Raco in step with the latest developments in the electrical field . . . have provided Raco • All-Steel • Products for every type of construction, for old and new building, for repair and maintenance jobs. Be sure—look for the Raco trade-mark. You can always RELY on RACO! It's the better line that is *sold nationally only through wholesalers.*

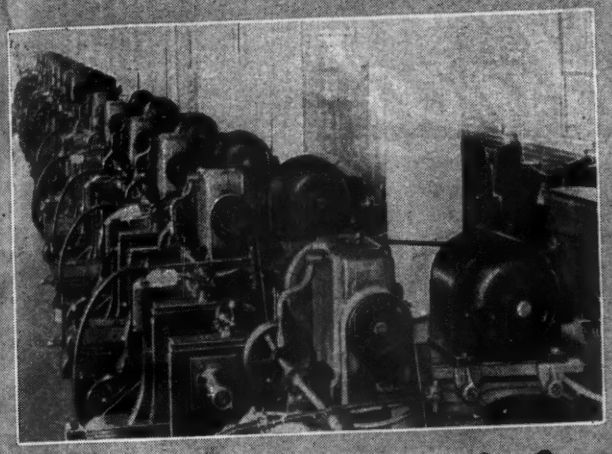
← DO-25 NJK—*Check this box carefully—for use with* either *BX or Non-metallic. More wiring room.*

CATALOG C-44—*New, up-to-date, see connector chart, comparative Box number chart and other helpful information.* →

ALL-STEEL-EQUIP COMPANY, INC.
600 Kensington Avenue, Aurora, Illinois

RACO • ALL-STEEL • PRODUCTS
SWITCH BOXES • OUTLET BOXES • CONDUIT FITTINGS

BEARINGS BEAR UP



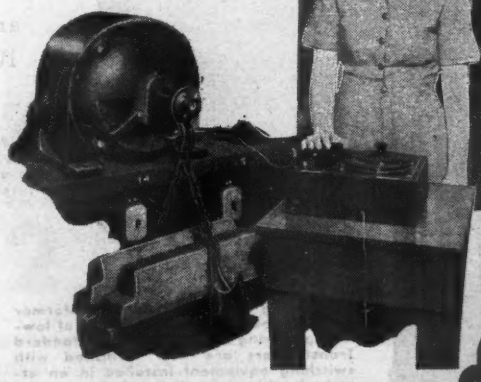
Powered by Tri-Clad sleeve-bearing motors, this battery of milling machines has been in round-the-clock operation on war work since before Pearl Harbor. The short-center, hinge-base drives put a hard, steady pull on the motor bearings. In addition, the machines are in the hands of several different operators each day, many newly trained. Despite the severe service, motor-bearing performance has been above prewar levels. Maintenance manpower has been conserved, and production held on schedule.

Tri-Clad motors driving milling machines in the River Plant Division of the Savage Arms Corp., Chicopee Falls, Massachusetts.

How torture tests on TRI/CLAD bearings have helped us lengthen motor life

Before the Tri-Clad motor-bearing designs were adopted, many models of this new motor were tested to destruction under heavy shaft loadings applied from all directions, with various kinds of lubricants, and under many different speed and temperature conditions. As new Tri-Clad types are introduced, these tests continue—some for years—in "torture" areas such as shown at right. Each test broadens our knowledge, offers new clues to longer motor life. Throughout industry, results have substantiated the improved bearing performance forecast by these tests.

General Electric Company, Schenectady 5, New York.



GENERAL ELECTRIC

Buy all the BONDS you can — AND KEEP ALL YOU BUY

Standard Askarel-Cooled distribution transformer . . . 250 Kva, 2300—115/230 volt, single phase, 60 cycle.

To save space, reduce costs with complete safety

SPECIFY

Standard

TRADE MARK

ASKAREL* COOLED

Transformers

For industrial plants or commercial buildings, you can save time and floor space by installing Standard ASKAREL-COOLED Transformers. Built to AIEE and NEMA specifications, these Standard units are *entirely safe and approved* for use up to rated capacities outdoors or indoors without separate housing or vaults. Good engineering on your part takes advantage of Standard Askarel economies to improve your proposals.

Some of the more popular designs are illustrated here. Capacities up to 10,000 Kva are available.

2400 Kva, three phase, Askarel-Cooled Standard Power Transformer. Years of user experience has proved the economy and dependability of Standard Askarel-Cooled Transformers.

Design typical of ratings up to 50 Kva inclusive. High and low voltage terminals can be arranged for housing with switch and fuses as specified.

By locating this distribution transformer near the load center, costly runs of low-voltage wiring are saved. Many Standard Transformers are now furnished with switching equipment installed in an attached cabinet as shown here. Being Askarel-Cooled, it is safe anywhere.

*ASKAREL, a non-inflammable, non-explosive liquid is approved by the Underwriters Laboratories to be used as an insulating and cooling medium. The National Electric Code allows Askarel-filled transformers to be installed indoors without fireproofing. Write for Bulletin S-101.

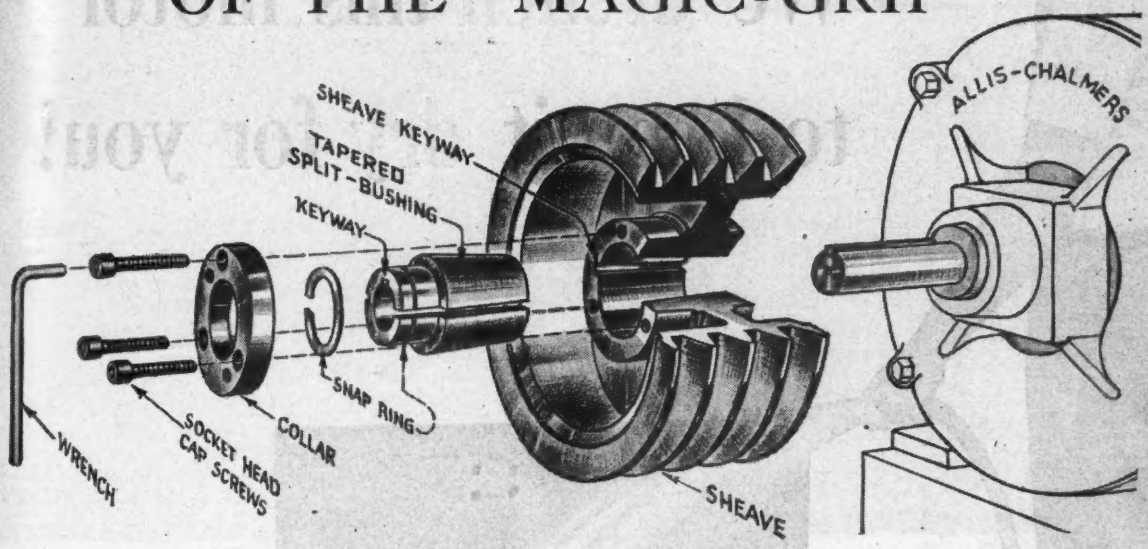
THE STANDARD TRANSFORMER COMPANY

WARREN, OHIO

Makers of: Power, Distribution, Rural, Instrument, Street Lighting and Testing Transformers . . . Oil, Askarel or Air Cooled

Here's the Secret

OF THE "MAGIC-GRIP"



Exploded view shows why Allis-Chalmers' new "Magic-Grip" Sheave goes on *as a unit in 3 easy steps.* It's the fastest mounting sheave on the market—at no extra cost.

1 Place sheave on shaft. Slides on smoothly because clearance is provided by expanded bushing. There's *no* hammering — *no* forcing! Complete sheave and bushing unit comes intact—ready for quick, easy mounting.

2 Slide to desired position. Sliding easily, sheave can be placed *exactly* according to straight-edge . . . giving you true alignment with resulting smooth performance. A minimum of time is required.

3 Tighten three capscrews — and it's ready to go! Entire sheave is locked securely to shaft and *grips like magic!* No set screws to damage shaft. Send for Bulletin B6310. Allis-Chalmers, Milwaukee 1, Wis.

A 1764

Allis-Chalmers Texrope

"MAGIC-GRIP" SHEAVES

We drench this motor to keep it dry for you!

Say you buy a motor for use in a wet area. You ask for a splash-proof type. If it keeps running, the motor probably has all the protection its name plate implies. If it stops, well . . . but then it's too late!

Knowing what you're up against, Robbins & Myers' engineers take nothing for granted. They *design* Uni-Shell Motor heads to withstand the entrance of liquids reflected against the motor. And then, they *test* them with a hose under actual operating conditions to make sure that their calculations are correct, that no water gets inside.

Let this kind of "follow-through" engineering help you decide on the right model for your motor problem. And no matter which type of motor proves to be the answer, it is *interchangeable* with any other Uni-Shell Motor of the same frame size. That's something to count on when you relocate your motor-driven equipment in the days ahead.

To help you plan, now, an illustrated 20-page booklet on R & M Uni-Shell Motors contains information you need. A copy (mention Form 1845) is yours for the asking. Send for yours, today.

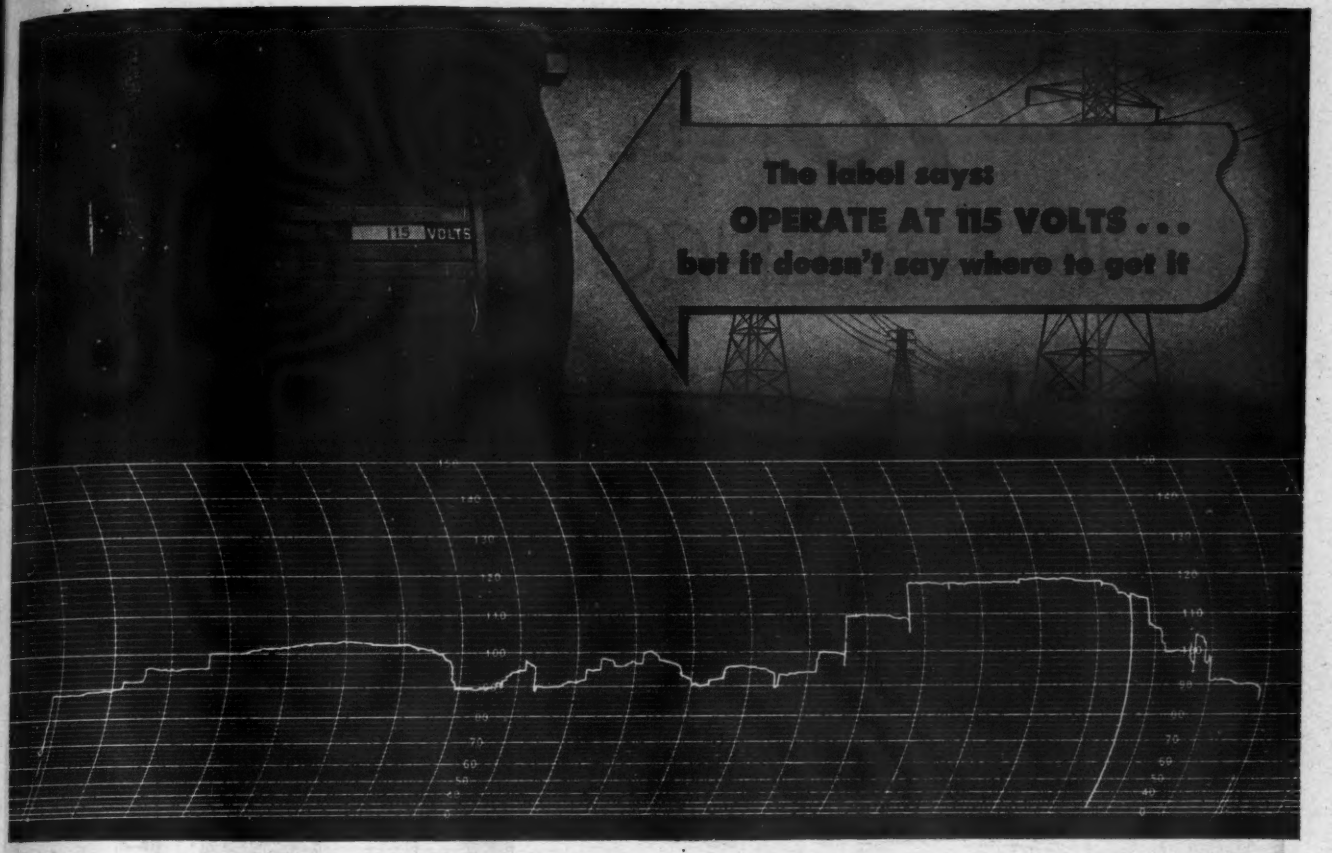
SHIPMENT NOW!

Ample stock on most types of integral motors on hand as this goes to press. Wire or phone your inquiry.

ARMY E NAVY

ROBBINS & MYERS · INC. MOTOR DIVISION · SPRINGFIELD, OHIO
In Canada: Robbins & Myers Co., of Canada, Ltd., Brantford, Ont.

MOTORS · HOISTS · CRANES · MACHINE DRIVES · FANS · MOYNO PUMPS · FOUNDED 1878



RATED VOLTAGE is always available to equipment protected with built-in CONSTANT VOLTAGE

"Operate at 115 volts" on the label of electrically operated precision equipment is not simply informative —*it's a warning!*

A *warning* that the device is too sensitive to tolerate the voltage fluctuations that may be met on America's power lines, and still perform with efficiency. A *warning* that sensitive tubes and other delicate mechanisms may be irreparably damaged by line surges and that costly replacements, with consequent loss of time and efficiency, lie ahead.

The design engineer who assumes that the precisely controlled voltages of the research laboratory will be duplicated in the field is heading his product toward trouble. Nominal line voltage ratings can no longer be used as single, stable reference points for design considerations. Commercial power lines are too heavily loaded and unpredictable.

"Operate at 115 volts" is no longer sufficient on a label. A guarantee that the "115 volts" will always be available, in spite of the unpredictable fluctuations of commercial power, is a prime requisite if the device is to perform with unfailing efficiency and precision.

The place to provide voltage control is within the equipment. With a Constant Voltage Transformer as a component part, the device is provided with a dependable source of voltage and unfailing protection against performance interference and construction damage.

SOLA Constant Voltage Transformers are available in sizes and capacities to meet design requirements of any electrically operated equipment or electronic device. Items so protected will deliver as efficiently in the field as under the most ideal laboratory conditions.

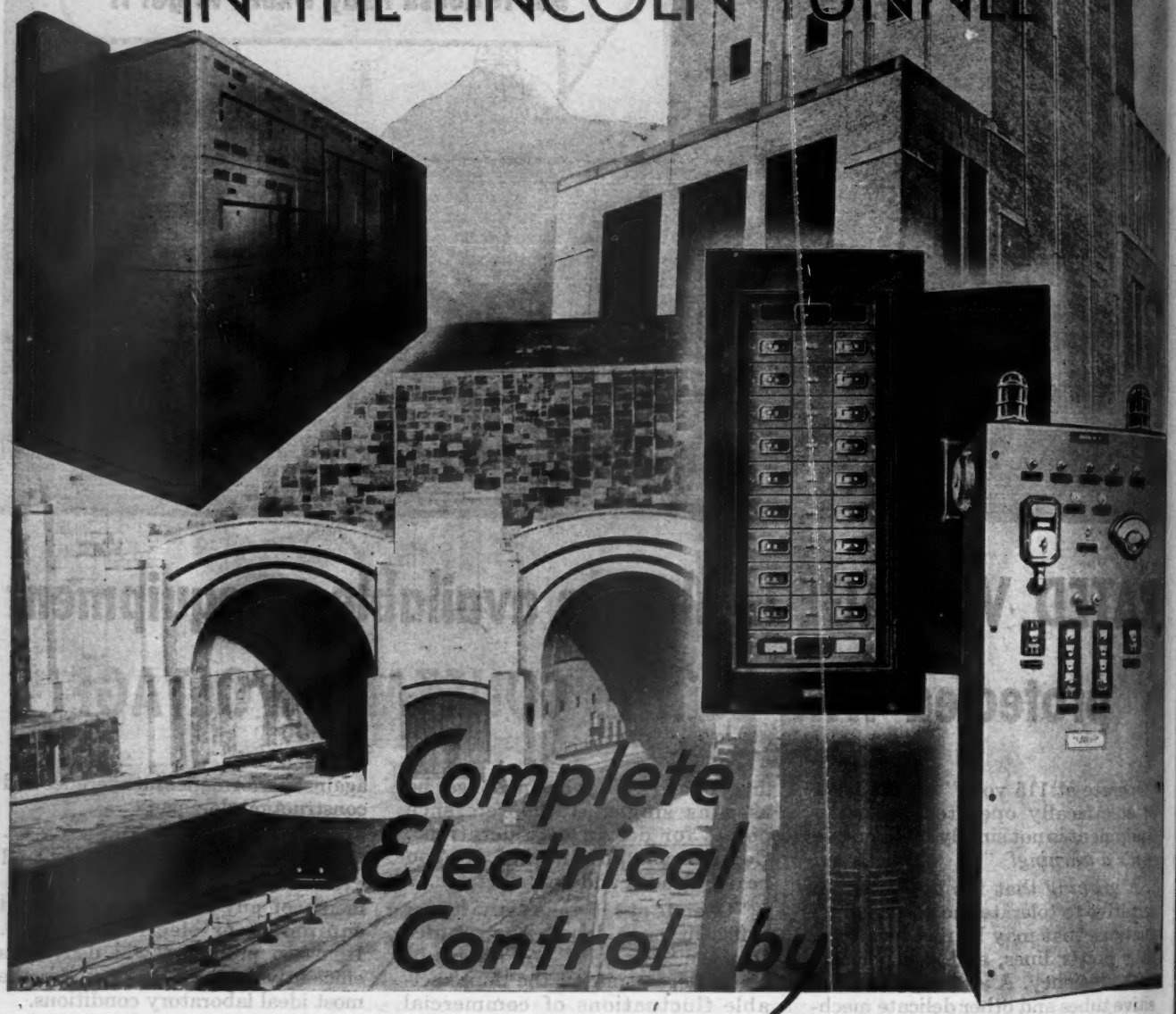
SOLA Constant Voltage Transformers have no moving parts to get out of order. There are no manual adjustments to be made. They perform instantly and automatically, maintaining output constant to within ± 1% of the rated voltage, regardless of line fluctuations as great as 30%.

To Manufacturers:
Built-in voltage control guarantees the voltage called for on your label. Consult our engineers on details of design specifications.
Ask for Bulletin JCV-74

SOLA Constant Voltage Transformers

Transformers for: Constant Voltage • Cold Cathode Lighting • Mercury Lamps • Series Lighting • Fluorescent Lighting • X-Ray Equipment • Luminous Tube Signs Oil Burner Ignition • Radio • Power • Controls • Signal Systems • Door Bells and Chimes • etc. SOLA ELECTRIC CO., 2525 Clybourn Ave., Chicago 14, Ill.

3 of the 18 METROPOLITAN ELECTRICAL UNITS IN THE LINCOLN TUNNEL

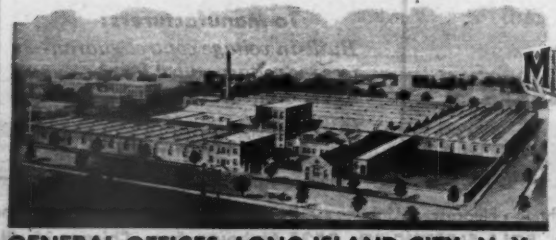


Complete Electrical Control by

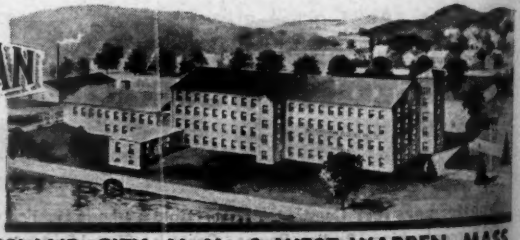
At the right are listed various types of electrical control equipment designed and furnished by METROPOLITAN for utilities, industrial plants, large mercantile establishments, and public buildings. Your inquiries are invited.

- Knife Switchboards
- Circuit Breaker Switchboards
- Dead Front Switchboards
- Battery Charging Switchboards
- Motor Control Switchboards
- Explosion-proof Switchboards
- Laboratory and Test Switchboards
- Control Switchboards
- Generator and Distribution Switchboards

METROPOLITAN ELECTRIC MANUFACTURING CO.



ESTABLISHED 1892
METROPOLITAN
TRADE MARK
ELECTRIC LIGHTING AND POWER DISTRIBUTION EQUIPMENT



GENERAL OFFICES: LONG ISLAND CITY, N. Y. FACTORIES: LONG ISLAND CITY, N. Y., & WEST WARREN, MASS.

THEY DON'T TAKE *Chances* HERE!

SANGAMO TIME SWITCHES
FOR
FLOODLIGHTING PROTECTION

THEY DONT TAKE CHANCES in thousands of floodlighting installations—they make sure, just as in the floodlighting installation pictured above, that the lighting stays bright and does its full job of protecting from dusk to dawn.

To accomplish this, buyers of floodlighting purchase SANGAMO Automatic Control. Tell your next floodlighting prospect about this protection and go after those floodlighting installations where there is no SANGAMO TIME SWITCH safeguard. Now is the time to get this profitable business.

There are types to meet every protective lighting control need. The complete line includes Astronomic Dial, Synchronous Carry-Over, and Outdoor Time Switches. Form VSWZ Astronomic Dial Synchronous Carry-Over Time Switch is shown above. Current interruptions up to 10 hours will not stop it nor affect its "on" and "off" settings.

WHERE THERE IS A NEED FOR FLOODLIGHTING···THERE'S A SALE FOR AUTOMATIC CONTROL···

SANGAMO ELECTRIC COMPANY SPRINGFIELD ILLINOIS

At your service!

CROUSE-HINDS

international distribution system

CONDULETS, made only by CROUSE-HINDS, are stocked by hundreds of **electrical wholesalers,** backed up by a large staff of Crouse-Hinds product engineers at **22** offices and **4** other strategic locations in the U. S. A.; the Crouse-Hinds Company of Canada, Ltd., in Canada; **22** Crouse-Hinds agents in Latin America.

There is an **electrical wholesaler** representing CROUSE-HINDS near you, ready and eager to render assistance in handling CONDULET problems. Call on him frequently.

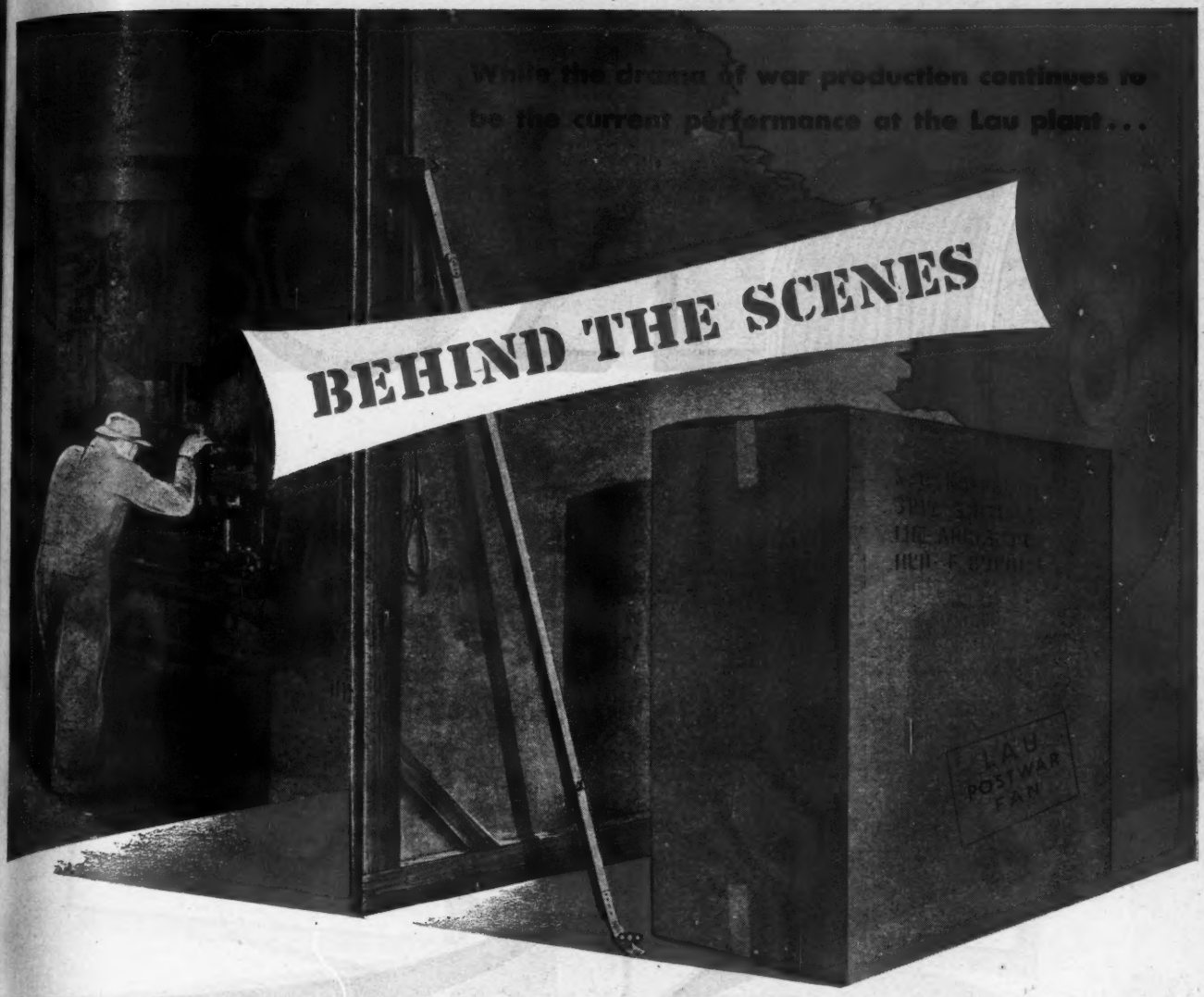
CROUSE-HINDS COMPANY

SYRACUSE 1, N. Y., U.S.A.

Offices: Birmingham—Boston—Chicago—Cincinnati—Cleveland—Dallas—Denver—Detroit—Houston—Indianapolis—Kansas City—Los Angeles—Milwaukee—Minneapolis New York—Philadelphia—Pittsburgh—San Francisco—Seattle—St. Louis—Washington. *Resident Product Engineers:* Albany—Atlanta—Charlotte—New Orleans

CROUSE-HINDS COMPANY OF CANADA, LTD., *Main Office and Plant:* TORONTO, ONT.

CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS


While the drama of war production continues to be the current performance at the Lau plant . . .
BEHIND THE SCENES
LAU
POSTWAR
FAN

NEW IMPROVEMENTS IN LAU FANS

await our presentation to a peacetime audience

We'll divulge all the details of recent Lau Fan improvements the moment the lid is off present-day restrictions . . . when our government and war-essential contractors to our government no longer require the limits of our production . . . when the general need for fans in industry and for commercial purposes can be supplied. Lau Fans which you will be able to obtain after the war will have improved construction features—better performance than ever—and they'll be obtainable at still lower costs as a result of Lau straight-line mass production. Look to Lau to continue as a leader in the fan and blower field. If you now are making your postwar sales plans to include a profitable line of exhaust-type fans, be sure to contact us so that we can keep you posted regarding our product development.

The majority of Lau Fans and Blowers is going into direct and indirect war applications. However, we are producing a limited quantity of industrial and commercial fans which are available on proper priority. Contact your nearest Lau jobber.

Package Units

Blower Assemblies

Propeller Fans

Blower Wheels

THE LAU BLOWER COMPANY

DAYTON 7, OHIO, U. S. A.

WORLD'S LARGEST MANUFACTURER OF FURNACE BLOWERS

Engineers and fabricators of general Air Handling Equipment • Single Inlet and Double Inlet Blowers • Propeller Fans • Accessories

ROE

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ROEBLING ELECTRICAL WIRES AND CABLES

WEATHERPROOF WIRE • RUBBER COVERED WIRES AND CABLES • SERVICE ENTRANCE CABLES INCLUDING THIN-WALL INSULATED BUILDING WIRES AND CABLES) • RUBBER SHEATHED PORTABLE CABLES • RUBBER INSULATED POWER CABLES • TELEPHONE WIRES • VARNISHED CAMBRIC POWER CABLES • MAGNET WIRE BARE COPPER STRAND • PIGTAIL AND BRAIDED COPPER • TROLLEY CONTACT WIRE

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PACEMAKER IN WIRE PRODUCTS

BLING

for your Profit!

1. The finest in electrical wires and cables from **ROEBLING**

2. The best in service from **ROEBLING ELECTRICAL WHOLESALERS**

EVER STOP TO THINK that the best products in the world aren't very helpful unless you get them when and where you want them? And at the right price?

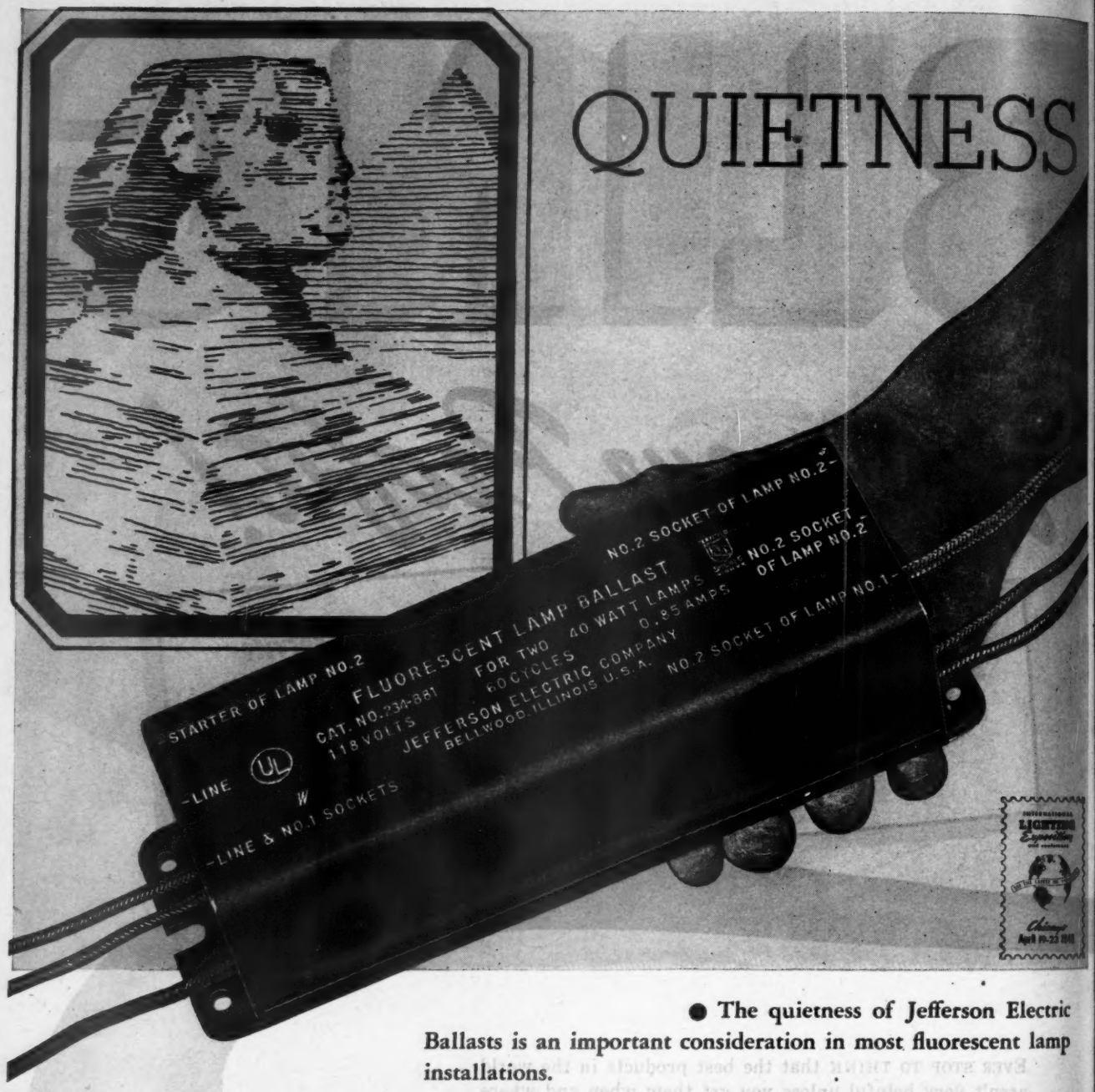
Thank your electrical wholesaler for *that* part of a job well done . . . even under the strain of total war, with increased demands and limited supplies.

That's why Roebling will continue to team up with electrical wholesalers now and always. We'll do our part of the job with a complete line of wire and cable that embodies every modern development and assures the best possible service. Roebling wholesalers will see that you get them, and hundreds of other fine electrical products too.

Roebling and your local wholesaler . . . it's a team that you can't beat when you want the best products and service. Teamed for *your* profit!

JOHN A. ROEBLING'S SONS COMPANY
TRENTON 2, NEW JERSEY

Branches and Warehouses in Principal Cities
Roebling Wholesalers in Strategic Localities



This type arranged for leads to extend at ends or from bottom.

● The quietness of Jefferson Electric Ballasts is an important consideration in most fluorescent lamp installations.

This quiet operation is a result of correct engineering, careful selection of all materials, control of assembly, processing, and inspection—production of every part under Jefferson supervision and under one roof.

Quietness is further evidence of high quality in large scale Ballast production; a Jefferson Electric characteristic recognized by experienced lighting engineers and fixture manufacturers . . . New Bulletin 441-FL contains the latest engineering data. JEFFERSON ELECTRIC COMPANY, Bellwood (Suburb of Chicago), Illinois. *In Canada:* Canadian Jefferson Electric Co., Ltd., 384 Pape Avenue, Toronto, Ont.

These Ballasts too are approved by the Underwriters' Laboratories, Inc., and have the ETL certification.

Instant Starting Ballasts are now available in two-lamp 40-watt sizes, making starting possible without separate starter action or cathode pre-heating.

JEFFERSON ELECTRIC

FLUORESCENT LAMP BALLASTS

Sold through recognized independent wholesalers

HAZARD INSULATED WIRE WORKS

ARMY NAVY

Division of The Okonite Company

Wilkes-Barre, Pennsylvania

PANTHER & DRAGON FRICTION & RUBBER TAPES

3879

FARADAY

THE HOUSE OF SIGNAL SERVICE SINCE 1884

Announcing...

the acquisition by the Faraday Electric Corporation of the signal systems business of the Holtzer-Cabot Electric Company of Boston

Combining this old established signal systems business with our Stanley & Patterson Division will result in the widest and most complete line of signal systems equipment in the country.

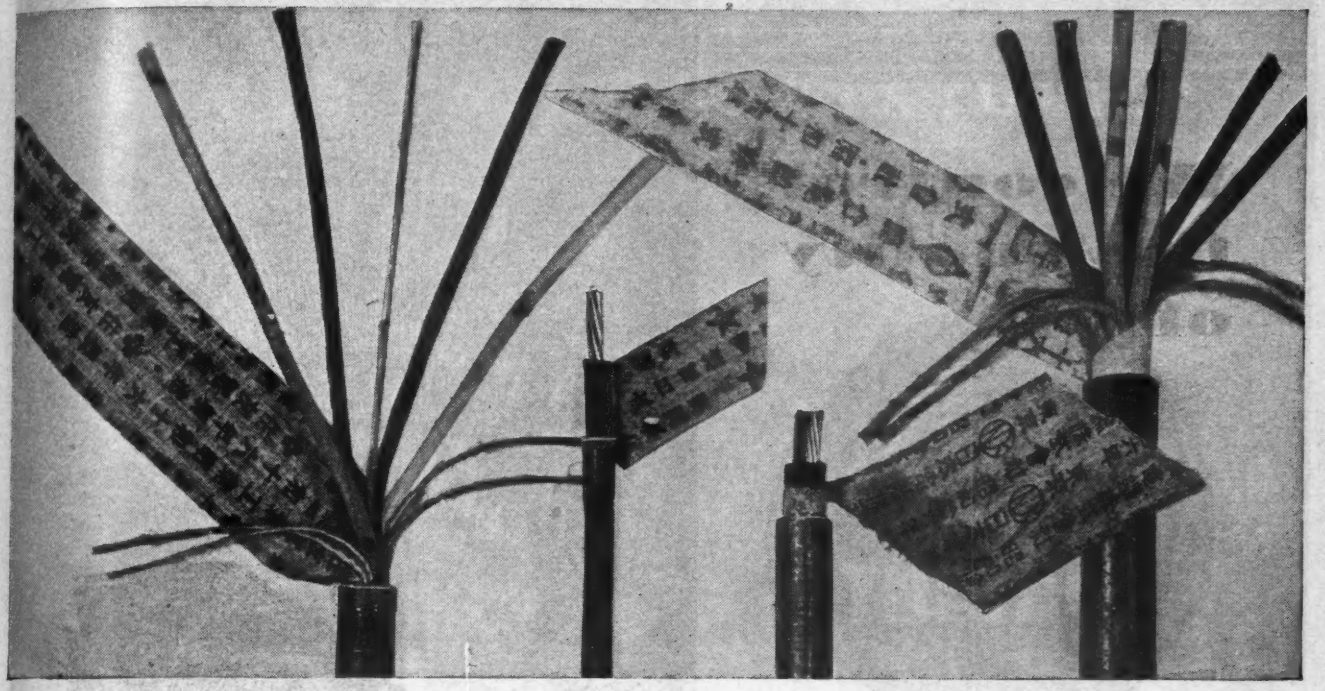
The rigid standards of efficiency and quality and the high type of service which have been established by each of these organizations in the past will, of course, be maintained in the future. Manufacturing will be done in Adrian, Michigan and Boston, Massachusetts.

STANLEY & PATTERSON DIVISION

OF FARADAY ELECTRIC CORPORATION · ADRIAN, MICHIGAN

DISTRICT OFFICES IN: ATLANTA • BIRMINGHAM • BOSTON • CHICAGO • CLEARWATER • CLEVELAND • DALLAS • DENVER DES MOINES • KANSAS CITY • LOS ANGELES • MEMPHIS • MINNEAPOLIS • NEW ORLEANS • NEW YORK • PHILADELPHIA • PITTSBURGH RICHMOND • ST. LOUIS • SAN FRANCISCO • SALT LAKE CITY • SEATTLE • WASHINGTON • **IN CANADA:** BURLEC LIMITED, TORONTO 13

Found: - On the Road to Tokyo ... Insulated Wires and Cables



These are not Simplex cables. They are not cables you would care to buy or use. They were picked up by one of our own men on the "road to Tokyo" and probably were "Made in Japan." They are of interest solely because they are enemy cables used by the Japanese while they occupied the Solomon Islands.

The cables in which we are more interested are the ones that you will need to carry out your postwar plans. Specially designed cables will be your best buy wherever you have unusual installation hazards or operating conditions. In writing specifications for such cables our long experience can be of help to you.

If you are looking for economical, efficient cable performance for communication, remote control or power transmission, you can get it with a Simplex cable engineered to fit your job.

Simplex Wire & Cable Co., 79 Sidney Street, Cambridge 39, Mass.

ARMY E NAVY M

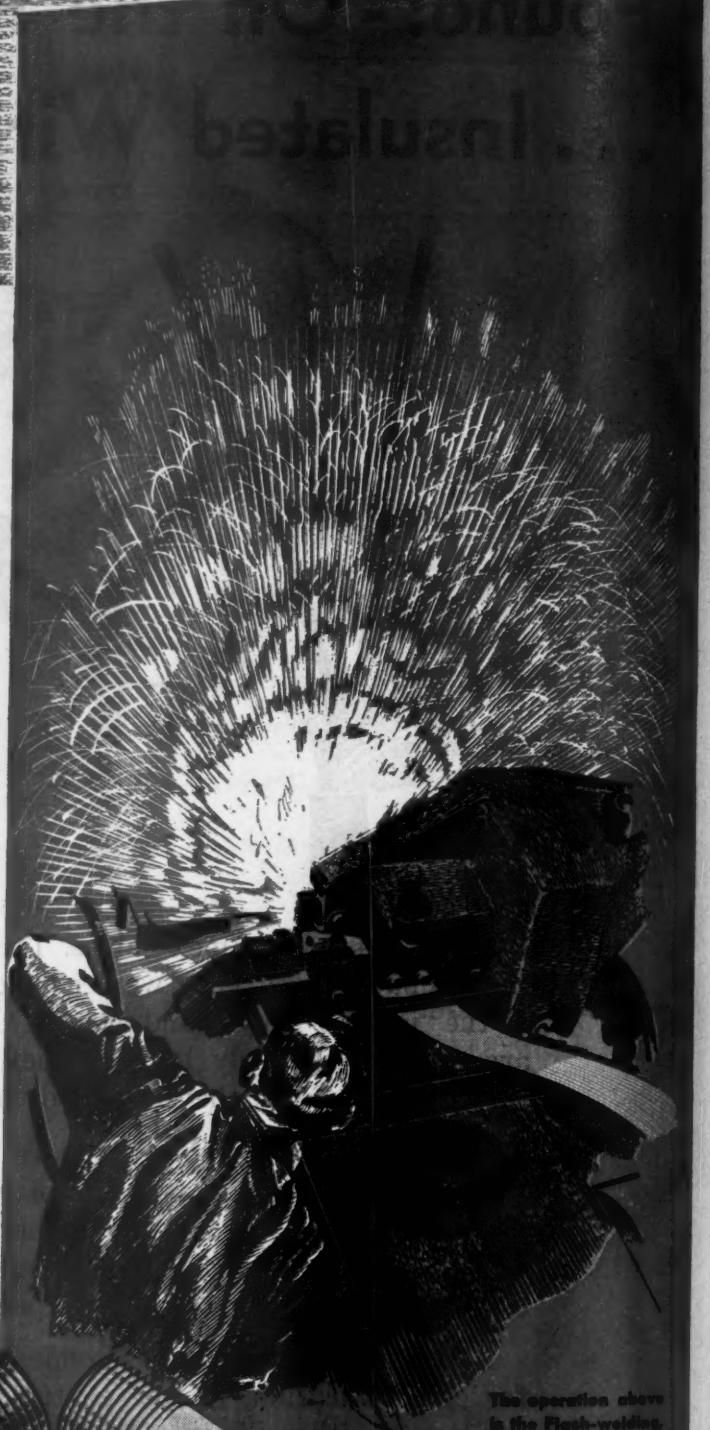
Simplex WIRES and CABLES

We control the quality of

CENTRAL RIGID STEEL CONDUIT

. . . because it is made in our own mills, from time tested Spang pipe.

"There's Tested Strength in Every Length"



The operation above is the Flash-welding, end to end, of steel skelp into an endless steel strip preparatory to heating, forming, and welding into Continuous Weld Pipe, which is further processed into finished CENTRAL Conduit.

SPANG-CHALFANT

Division of The National Supply Company

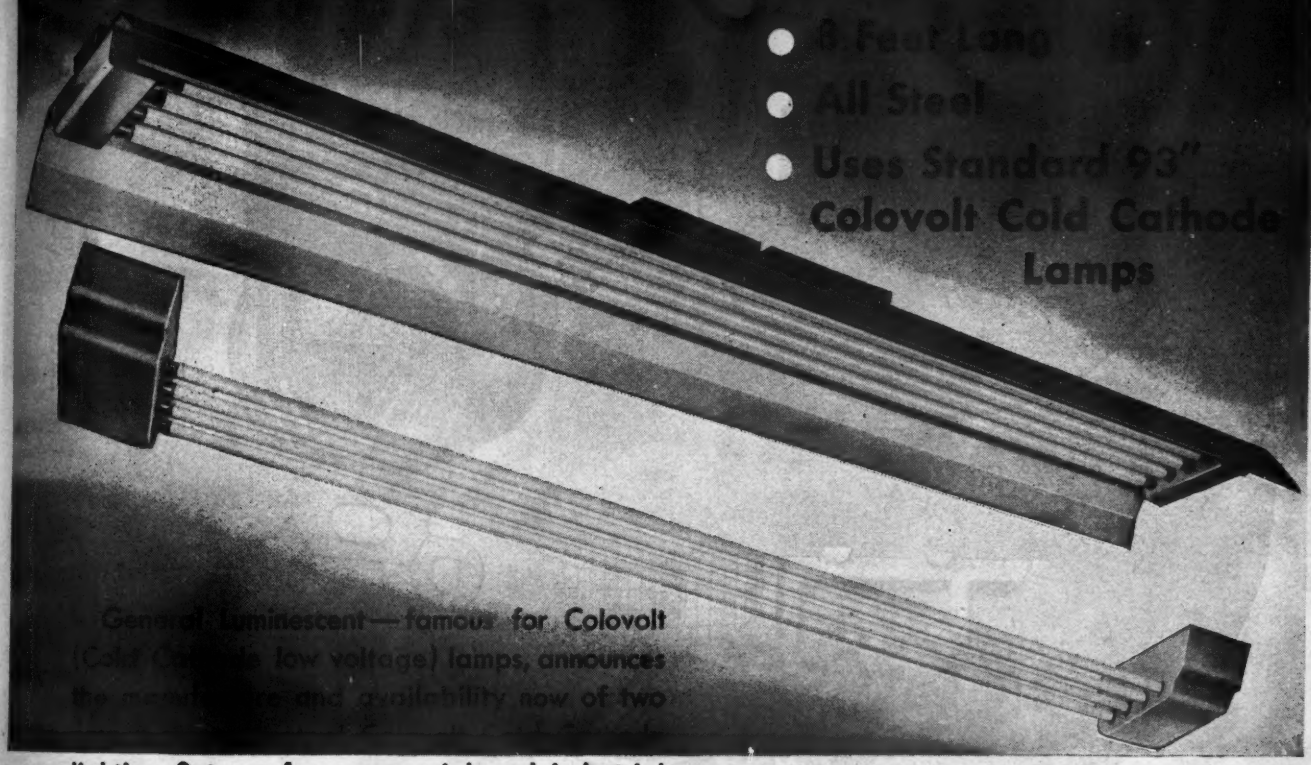
General Sales Office: Grant Building, Pittsburgh 30, Pa.

District Offices and Sales Representatives in Principal Cities

Now!

*COLOVOLT

COLD CATHODE FIXTURES



General Luminescent—famous for Colovolt (Cold Cathode low voltage) lamps, announces the manufacture and availability now of two lighting fixtures for commercial and industrial applications in a standard "packaged" unit.

Both of these fixtures use standard 93" Colovolt 10,000 hour lamps and can be used singly or in continuous line lighting in multiples of 8 feet. Instantaneous starting, no flickering, guaranteed for 1 year except for failure due to breakage, and the fact that the long life expectancy of Colovolt lamps may be realized even when constantly turned on and off, are additional advantages.

Contact your electrical wholesaler or jobber or write us for full details.

Above

INDUSTRIAL UNIT—The Industrial Fixture, designed to give the maximum of lighting efficiency has an all-steel 8-foot baked white enamel reflector which is easily removed for cleaning. Four lamp fixture delivers 8800 lumens. Also available in a two-lamp fixture.

Below

SIMPLICITY UNIT—The "Simplicity" Lighting Unit for commercial uses is distinctive in design, easy to install and simple to maintain. This 4-lamp fixture delivers 8800 lumens.

* Trade Mark registered U. S. Pat. Off.

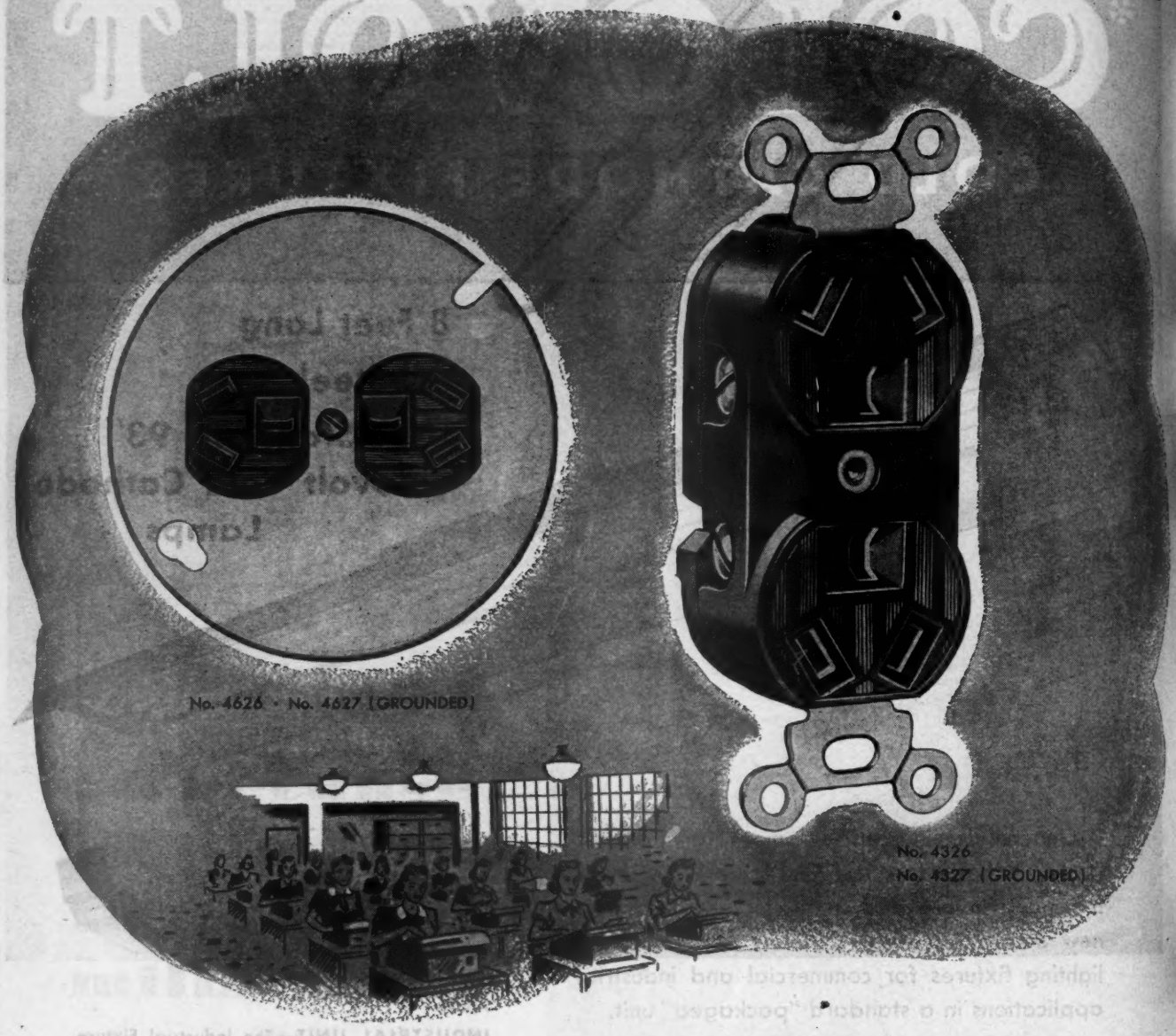
General LUMINESCENT CORPORATION

GENERAL LUMINESCENT CORPORATION

672 SOUTH FEDERAL STREET • CHICAGO 5, ILLINOIS

For safety's sake . . .

USE BRYANT 3-WIRE POLARIZED OUTLETS



Electrically operated business machines frequently present an unpleasant hazard to their operators, unless proper protective measures are adopted. Recognizing this, many alert business organizations are today grounding their equipment with 3-wire connectors.

Bryant 3-wire polarized outlets are ideal for this type of service. Consider these important advantages:

TAKE TWO ARMORED CAPS—These Bryant devices will accommodate two armored caps simultaneously.

PROPER POLARITY MAINTAINED—Regardless of which outlet in the device is used, proper polarity is maintained.

TOTALLY ENCLOSED—These 3-wire convenience outlets are totally enclosed and insulated in a rugged bakelite housing.

LARGE BINDING TERMINALS—Facilitate easy wiring and installation.

AVAILABLE with grounded yoke for 2-wire-and-ground service or with ungrounded yoke for 3-wire service.

Specify Bryant Devices from your Electrical Wholesaler

ARMY (E) NAVY

THE BRYANT ELECTRIC COMPANY

BRIDGEPORT 2, CONNECTICUT

NEW YORK • SAN FRANCISCO • CHICAGO • LOS ANGELES

A SUBSIDIARY OF WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY

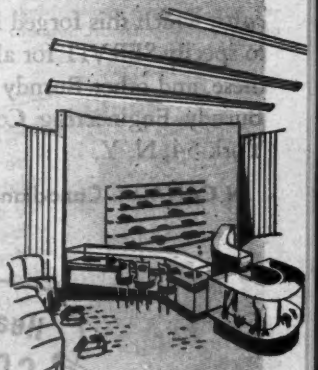
BRYANT
SUPERIOR WIRING DEVICES

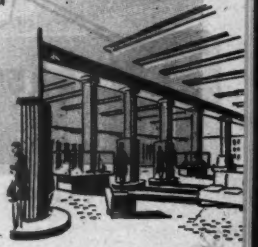
UTILIZING THE NEW MAZDA "SLIMLINE" LAMPS

When peace comes, *Mitchell* will offer a complete line of Longfellow fixtures, using the new MAZDA Slimline Fluorescent Lamps. Fixtures that will be instant starting, that will have no starter to replace. Designed for new grace, flexibility and beauty, the slim new Longfellow is a Poem of Light.

But that is only part of the story, *Mitchell's* Longfellow fixtures will give you many new advantages in creating new and interesting lighting effects.

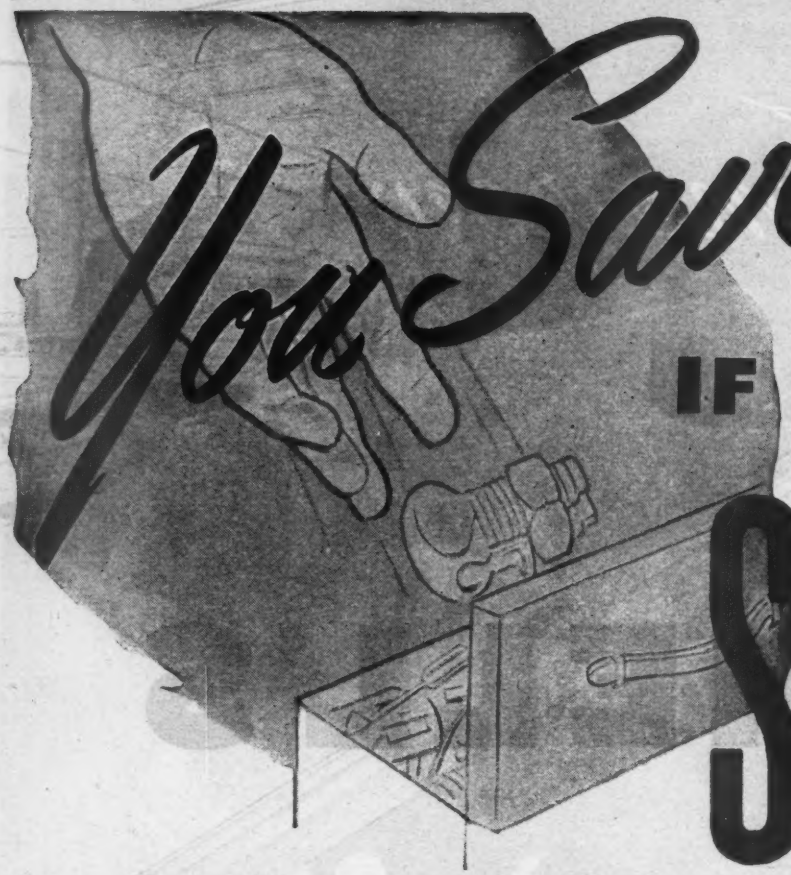
Mitchell, as always, is conspicuously *first* in introducing new and better lighting equipment. *Mitchell* quality and *Mitchell* design are recognized as unsurpassed in the fields of commercial and industrial lighting equipment.





MITCHELL MANUFACTURING COMPANY, 2525 CLYBOURN AVE., CHICAGO 14, ILL.

WEST COAST FACTORY AND SALES OFFICE, 1019 N. MADISON AVE., LOS ANGELES 27, CAL.



You Save it IF IT'S A SERVIT

(Reg./Trade-mark)

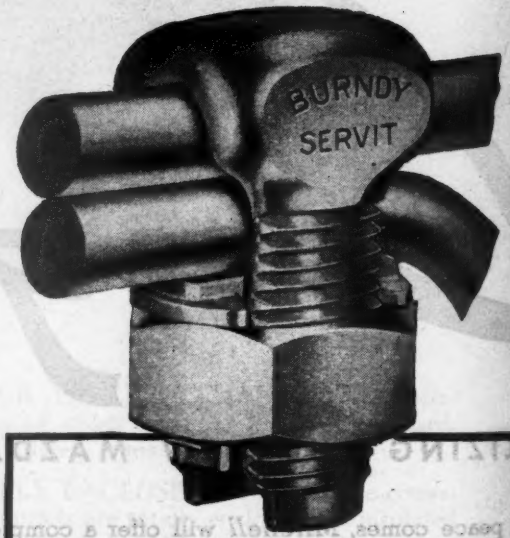
This FORGED Burndy service connector can be used over and over again!

"We use the SERVIT because it has far higher salvage value," recently stated a prominent utility EE in discussing service connectors.

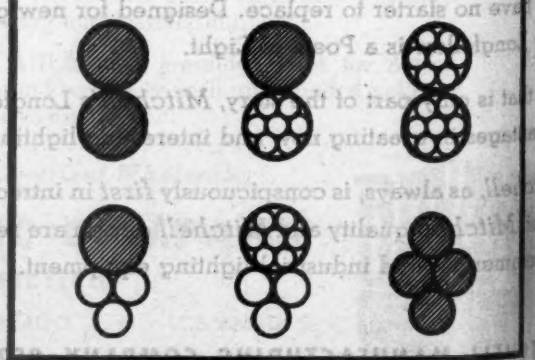
This advantage of *high reuseability* can only be obtained from a connector which possesses unusually high strength *... and the SERVIT has that in abundance.* Skillfully forged, from special high-strength alloys, it permits high compression between conductors, yet, withstands wrench torque, without distortion, *time and again!*

To be sure of obtaining the high salvage value, *lower costs,* which this forged Burndy connector provides, be sure to specify SERVIT for all service connections. Literature on these, and other Burndy connectors, gladly sent on request. Burndy Engineering Co., 107 Bruckner Boulevard, New York 54, N. Y.

IN CANADA: Canadian Line Materials, Limited, Toronto 13



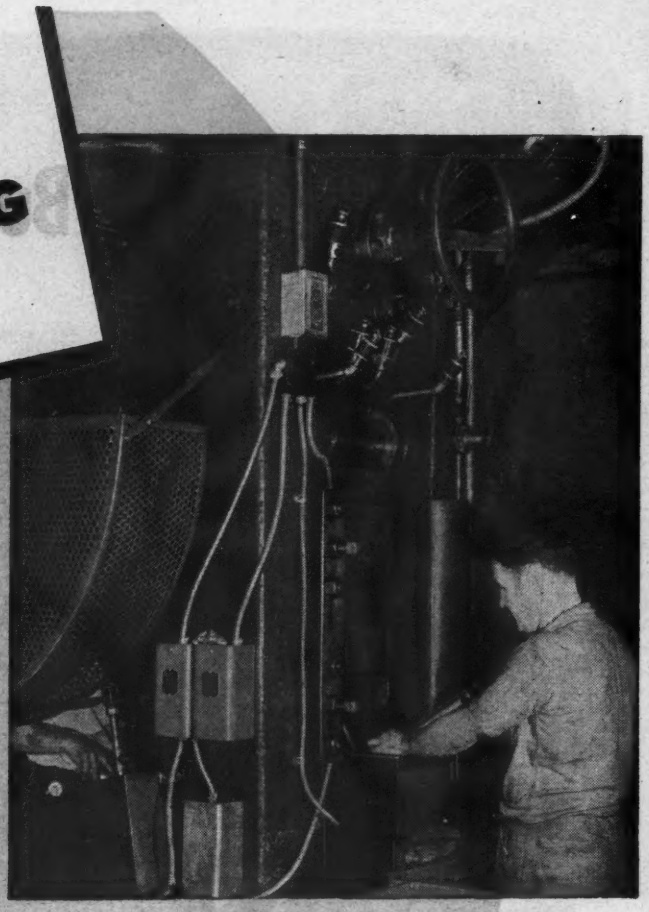
Patent No. 20,096



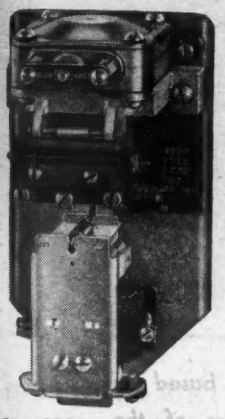
Headquarters for CONNECTORS

Burndy

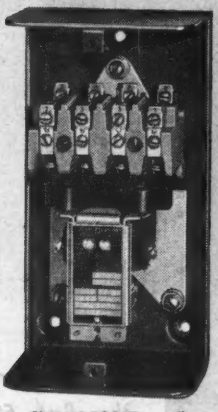
SQUARE D HEAVY DUTY CONTROL & TIMING RELAYS



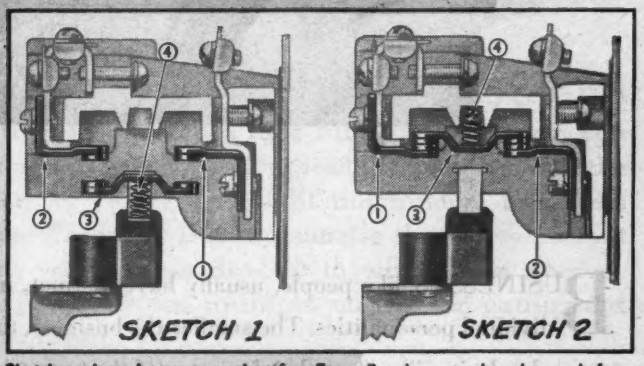
"Naturals" for reconverting or modernizing electrical control because they're designed for simplicity of operation and flexibility of application.



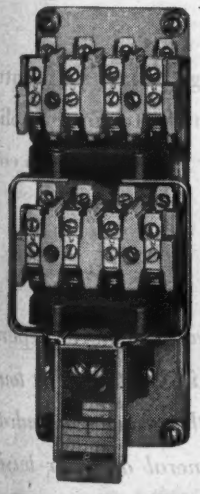
Class 9050 timing relay for .2 to 180 seconds delay.



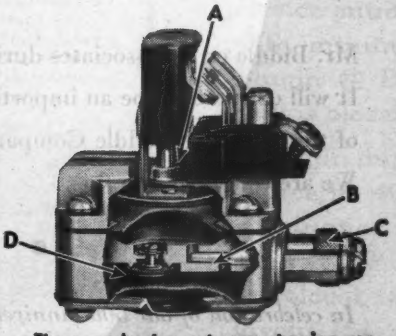
Class 8502 Type R four pole relay.



Sketches show how any pole of a Type R relay can be changed from normally open to normally closed (or vice versa) without additional parts. When parts numbered 1, 2, 3, and 4 in sketch 1 are removed and reassembled as in sketch 2, the contact is changed from normally open to normally closed.



Eight pole Class 8502 Type R relay.



Timer mechanism cutaway showing construction and method of operation. Spring action (A) moves contact member as quickly as air can transfer from lower to upper chamber through the restricted orifice (B). Turning the knurled wheel (C) regulates amount of restriction. A check valve (D) allows instantaneous resetting.

Call In a Square D Field Engineer

Your nearest Square D field engineer can help you find the right answers to your problems in expanding or modernizing electrical control systems. This counsel is available, without cost, through branch offices located in 50 leading U. S. and Canadian cities.

Write for Bulletins 8502 and 9050. Square D Co., Industrial Controller Div., Milwaukee 12, Wis.

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

"Our Business, Like Yours, ...is Different!"

A few comments based on the first 50 years of the JAMES G. BIDDLE COMPANY

BUSINESSES, like people, usually have distinct, individual personalities. The smaller the business, the more clearly it will reflect the character of the man who built it.

In 1895, when the electrical industry was in its infancy, James G. Biddle went into business as a manufacturer's agent, selling electrical measuring instruments and scientific apparatus. One of his basic aims in the conduct of the business was to be more than a mere source of supply. He decided to provide a service that was outstanding by reason of its alert, interested, personal character. This aim has never been changed by Mr. Biddle or his associates during the last half century. It will continue to be an important factor in the policies of the James G. Biddle Company in the years to come. We are committed to this.

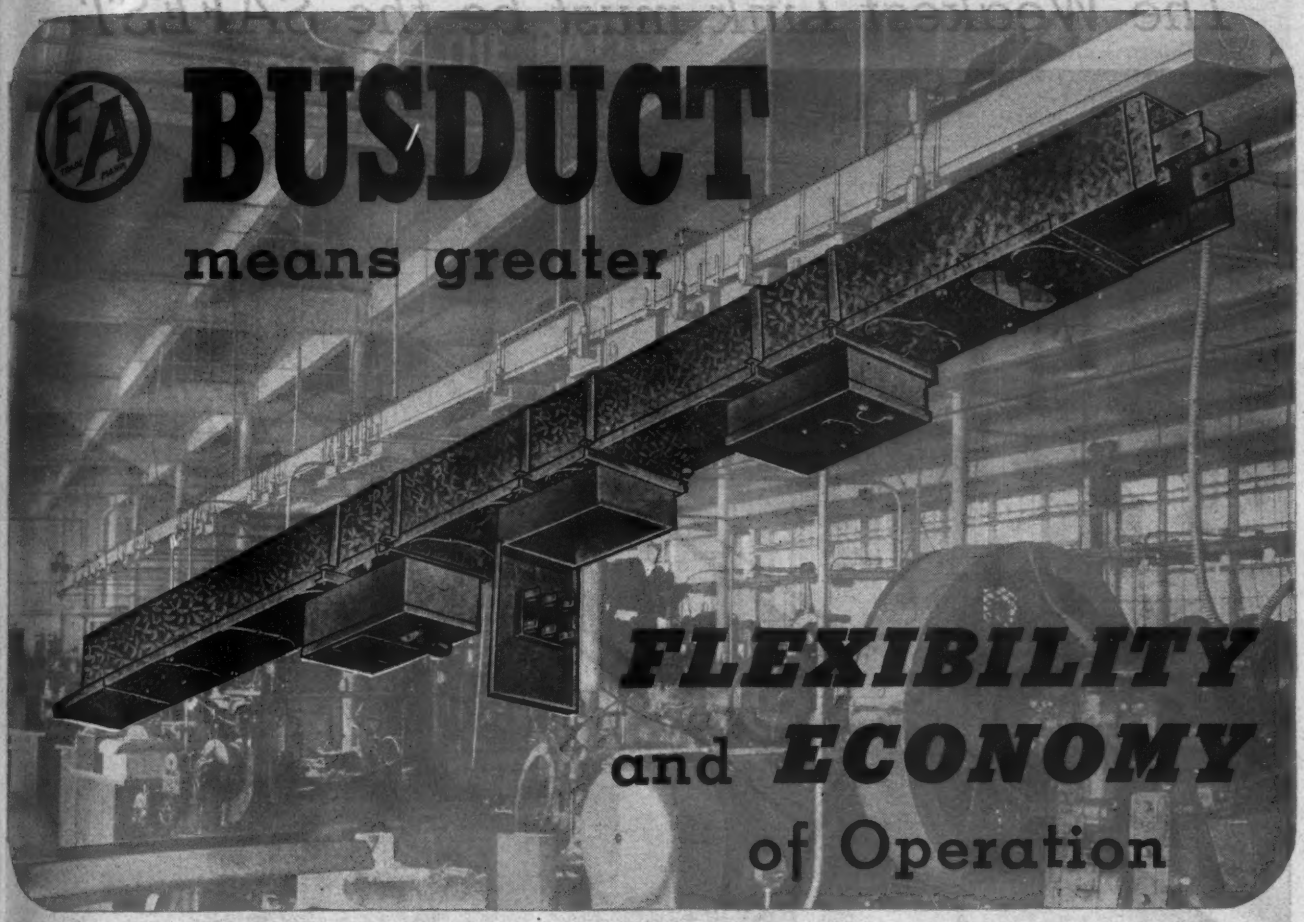
•

In celebration of our 50th anniversary, we have prepared a brief booklet entitled "Report at Mid-Century." It touches upon interesting points regarding the growth and advancements of the electrical field in general and our business in particular. We would be pleased to send you a copy upon request.

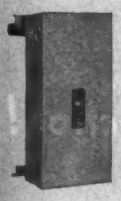
JAMES G. BIDDLE CO. • 1211-13 ARCH STREET • PHILADELPHIA 7, PENNA.

"MEGGER"* INSULATION TESTERS, GROUND TESTERS AND OHMMETERS • "FRAHM" TACHOMETERS AND FREQUENCY METERS • "JAGABI" RHEOSTATS • INDICATING HAND TACHOMETERS • SCIENTIFIC APPARATUS

*TRADE MARK REG. U. S. PAT. OFF.

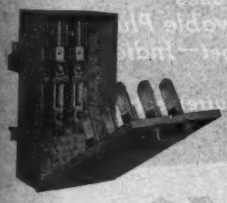


PLUGIN UNITS



Left: Circuit Breaker provides full automatic protection against short circuits or dangerous overloads. Time-delay action prevents unnecessary interruption of service.

Right: Shutlbrak operating switch incorporates Kamklamp fuseholders and pressure type solderless connectors in a unit designed for safety and efficiency.



Left: Klampswitchfax has silver-plated contact parts on an extra heavy insulating block. Easy to install and operate.

These three units can be arranged to attach on either or both sides of the Plugin Busduct. Their rugged construction permits heavy usage and frequent connect and disconnect to accommodate changing plant conditions.

Your electrical distribution problems

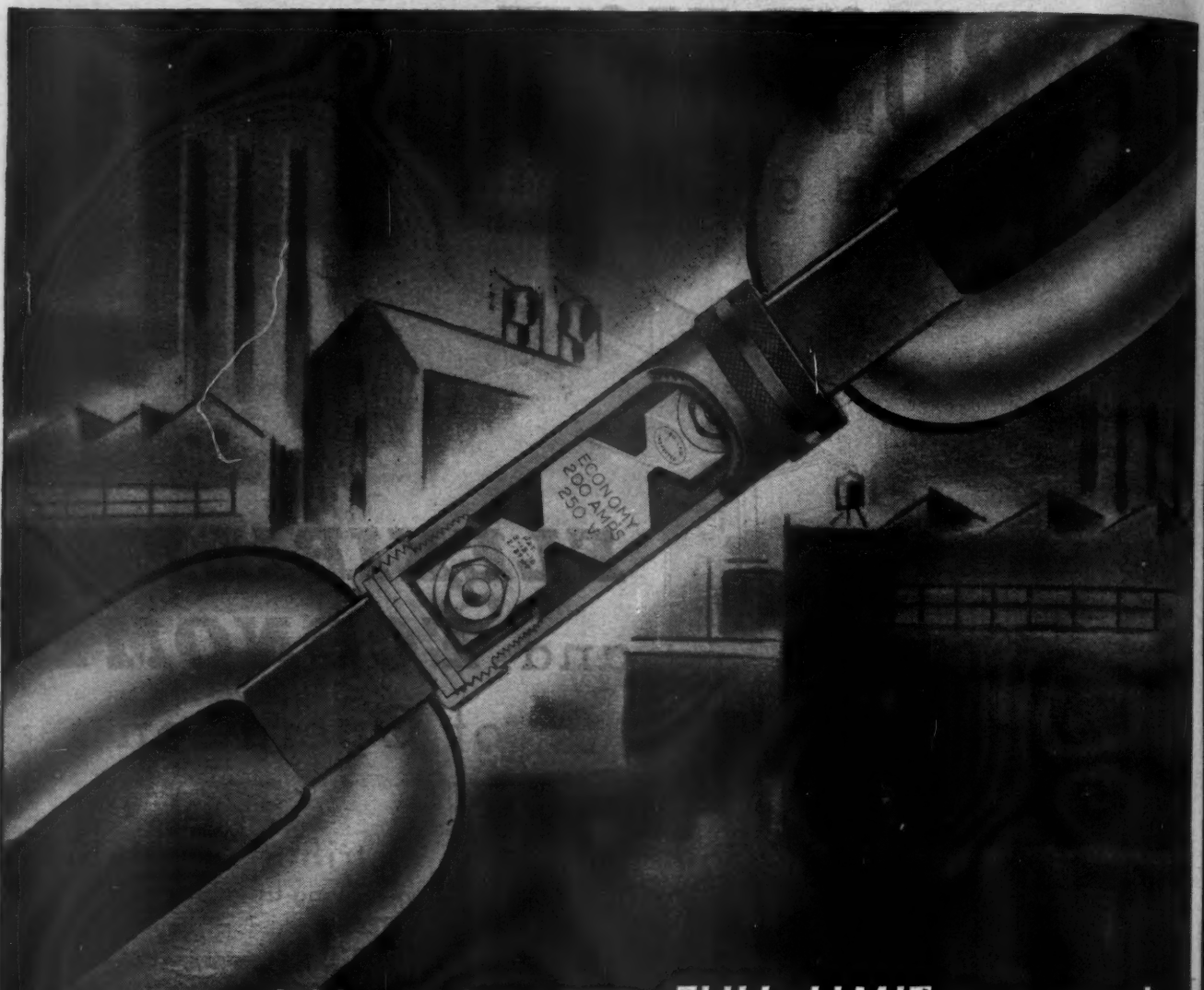
are solved for the present and a long time to come when you select Busduct. Correctly engineered, it provides all the capacity needed for heavy and light machinery. From the service entrance, Feeder Busduct carries the heavy current with minimum voltage loss directly to where it is needed. Plugin Busduct provides multiple outlets for equipment that is closely grouped.

A plugin outlet every foot means shorter distances from power source to machine . . . it means convenience, flexibility, the elimination of many long lead-ins with a consequent economy of operation. Convenient for adding new equipment . . . flexible for relocating present equipment or rearranging the entire plant layout, it is made in standard 10 foot sections that are easy to install and reassemble should the plant layout change again.

Busduct for lighting and power distribution is designed for 2, 3 and 4 wire systems, 250 volt DC and 575 volt AC maximum. Write today for Bulletin 65 giving complete descriptions. There is a Sales Engineer near you who will be glad to assist in planning new or extended electrical installations.

Frank Adam
ELECTRIC COMPANY
Box 357, ST. LOUIS, MO.

The Weakest Link must be the SAFEST—



. . . expendable . . . but giving FULL-LIMIT Protection!

A fuse *must* be "expendable" . . . weak enough to break down when danger threatens, yet strong enough to give the *full limit* of protection *before* it blows.

This full load capacity, uniformly maintained in every Economy Fuse, is a product of years of experience in fuse invention, pioneering, and development.

Examine any Economy Fuse—Note the distinguishing *"Drop Out" Renewal Link*, inexpensive, quickly and easily replaced . . . capacities made *plainly visible* to insure correct usage and ease of inspection . . . consistent protection at *full rated* capacities . . . cartridges that *last indefinitely* . . . unexcelled design, materials, workmanship.

Economy pioneered the first Renewable Link Fuse, the first to be approved by Underwriters' Laboratories. Leading wholesalers everywhere can supply you with Economy Fuses in all capacities for every type electrical circuit and purpose.

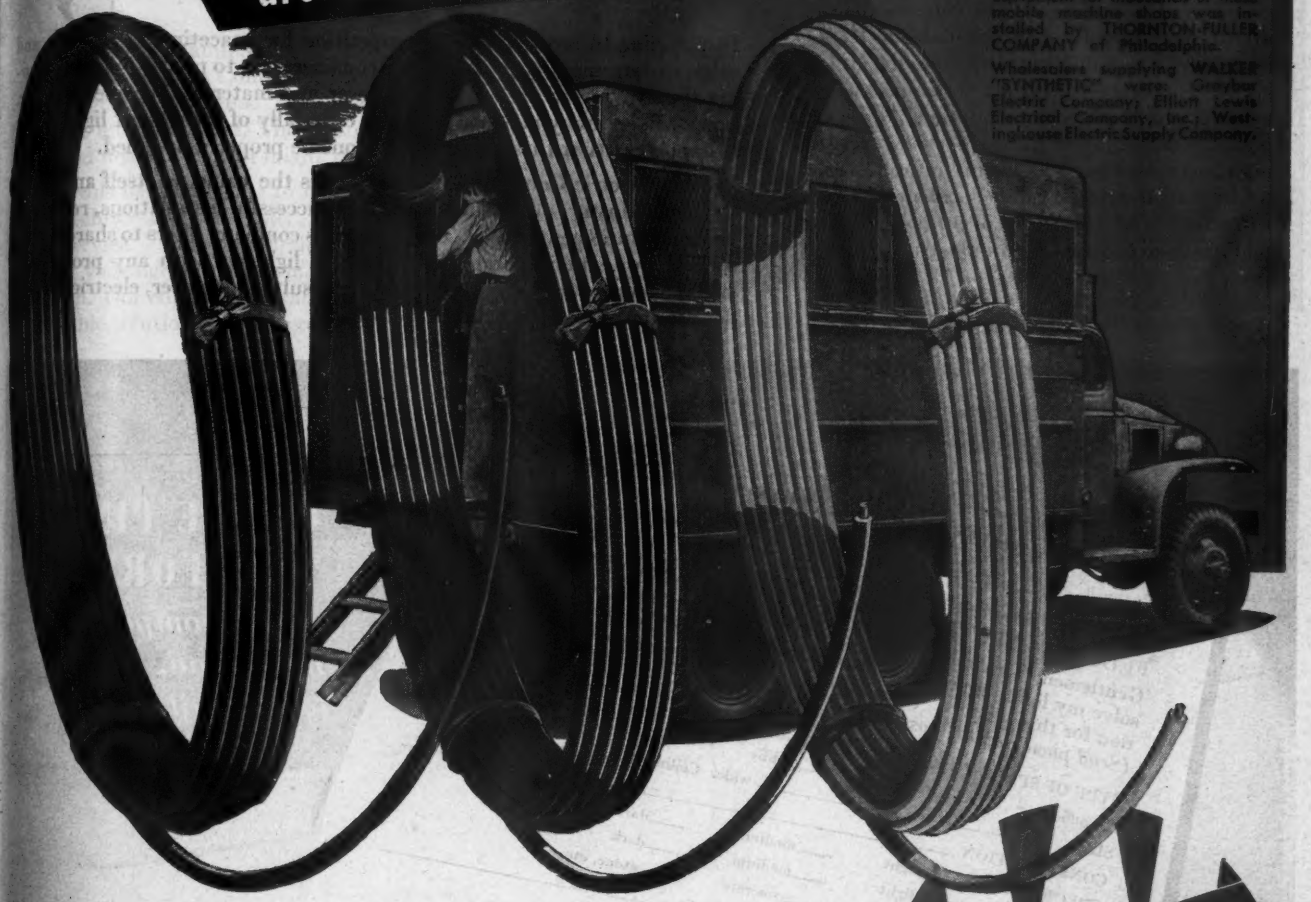
ECO—Non-Indicating, Non-Renewable
ECONOMY—Renewable
ARKLESS—Indicating, Non-Renewable
ECO Midget—Non-Indicating, Enclosed
ECONOMY Renewable Plug Fuses
CLEARSITE—Non-Renewable Plug Fuses
Special ARKLESS Midget—Indicating, Enclosed.
(Made for Precision Requirements)

Protection WITH ECONOMY

ECONOMY Fuse and Mfg Co.

2717 N. Greenview Ave. · Chicago, Illinois

REPAIR SHOPS OF THE BATTLE FRONTS are wired with WALKER "SYNTHETIC"



Equipment for thousands of these mobile machine shops was installed by THORNTON-FULLER COMPANY of Philadelphia.

Wholesalers supplying WALKER "SYNTHETIC" wires: Graybar Electric Company; Ellion Lewis Electrical Company, Inc.; Westinghouse Electric Supply Company.

Each is a self-contained, electrically-powered machine shop, fully equipped to render first aid to disabled mechanized units, and speed them back to the fighting fronts. In all parts of the world, you will find these mobile repair shops, working against time, and enduring hardships second only to those of the fighting machines they serve.

Toughness and efficiency are basic "musts" for every structural part. Machines, generators, and the wiring that carries the electric load must be able to stand up strong and long on a day-and-night shift that never ends. The wiring selected for this important job is WALKER "SYNTHETIC", a noteworthy tribute to WALKER quality and dependability.

WALKER "SYNTHETIC", built to the rigid requirements of war time standards, offers unlimited possibilities for peace time use. It is tough and long-aging . . . highly resistant to heat, cold, oils, alkalies, acids and moisture . . . extremely flexible and easy to handle . . . and it has high dielectric and mechanical strength.

WIRE WITH WALKER

Available in all standard colors—black, white, red, blue, yellow, green—and special shades on order. Sizes range from small diameter building wires up to 4/0.

Ask your Walker distributor for prices and delivery information. Or write to Walker Brothers, Conshohocken, Pa.

WALKER of Conshohocken

Makers of: Rubber-covered, Synthetic and Leaded Wires and Cables * "Walkertex" Non-metallic Sheathed Cables * Service Entrance Cables * Automotive Wires and Cables * Shipboard Cables * Leaded, Non-leaded, Synthetic or Varnished Cambric Insulation * Electric Metallic Tubing * "Dualcote" Rigid Steel Conduit * "Precut-Insert" Underfloor Distribution Systems.

FEDERAL ELECTRIC COMPANY, INC.

Lighting

What do you want to know about your lighting problem?

Federal Electric Company, Inc. offers help, through "Lighting Information Service." Fill in the form below, attach it to your company letterhead, and mail it, with a detailed letter if you wish. Federal Electric Company, Inc. lighting engineers will study your problem, and give you their recommendation. There is no charge or obligation for this service, except your cooperation in giving us full information. Available to architects, engineers, distributors, contractors, and managers of stores, offices, buildings, hotels, shops, and industrial plants.

In planning to meet the keen competition for peacetime production and sales, management is giving special consideration to proper lighting. During the conversion period, as manpower and materials become available, there will be many new installations, especially of fluorescent lighting. It is important that these new installations be properly designed.

Federal Electric Company, Inc. recognizes the value, to itself and to the lighting industry, of satisfied users, and successful installations, regardless of whose equipment is used. Therefore, this company offers to share, freely, its years of experience and knowledge of lighting, with any prospective user, in cooperation with his architect, consulting engineer, electrical goods distributor, and electrical contractor.

FREE LIGHTING INFORMATION SERVICE REQUEST FORM

Lighting Engineering Staff,
FEDERAL ELECTRIC COMPANY, Inc., 8700 S. State St., Chicago 19, Ill.
Gentlemen: The following information is given to assist you in helping me solve my lighting problem. I understand there will be no charge or obligation for this service. (*Please check or fill in proper spaces below*)
(*Send photograph if possible*)

TYPE OF SPACE TO BE LIGHTED ___factory (type) ___auditorium ___shop
___office ___store ___lobby ___halls

SIZE: _____ ft. long, by _____ ft. wide. Ceiling _____ ft. high

CONSTRUCTION ___light ___medium ___dark

COLORS: ceilings: ___light ___medium ___dark
walls: ___light ___medium ___dark
floor: ___wood ___concrete ___stone, etc.
___linoleum ___carpeted ___other

WINDOWS: Area, approx. square feet total _____ sq. ft.
Exposure: ___North ___West ___South ___East

PRESENT LIGHTING: type: _____ fc desired: _____ fc.
Footcandles (if known): present _____

CURRENT AVAILABLE: phase _____ cycles _____ volts _____

WORK OR USE for which lighting is required: ___general ___display ___reading
___drafting, proofreading, work on dark material ___decorative
___shop work, type _____

CHANGES CONTEMPLATED: (any changes in structure, equipment, colors, windows, or use of space, that would affect lighting—please state briefly) _____

MY PROBLEM: (state here, or in a separate letter if you wish, any specific questions, present problems, unusual or custom-built requirements, special colors or changes of lighting intensity to be included, architectural features such as concrete or steel beams, coves or troffers, etc.)

NAME: _____

POSITION OR TITLE: _____

PLEASE PIN THIS FORM *to your company letterhead, and mail*

Branch Offices: Cincinnati • Dallas • Duluth • Houston • Indianapolis • Kansas City • Louisville • Milwaukee • Minneapolis • New Orleans • New York • Philadelphia

ANNOUNCES HELP IN SOLVING YOUR LIGHTING PROBLEMS

Information Service

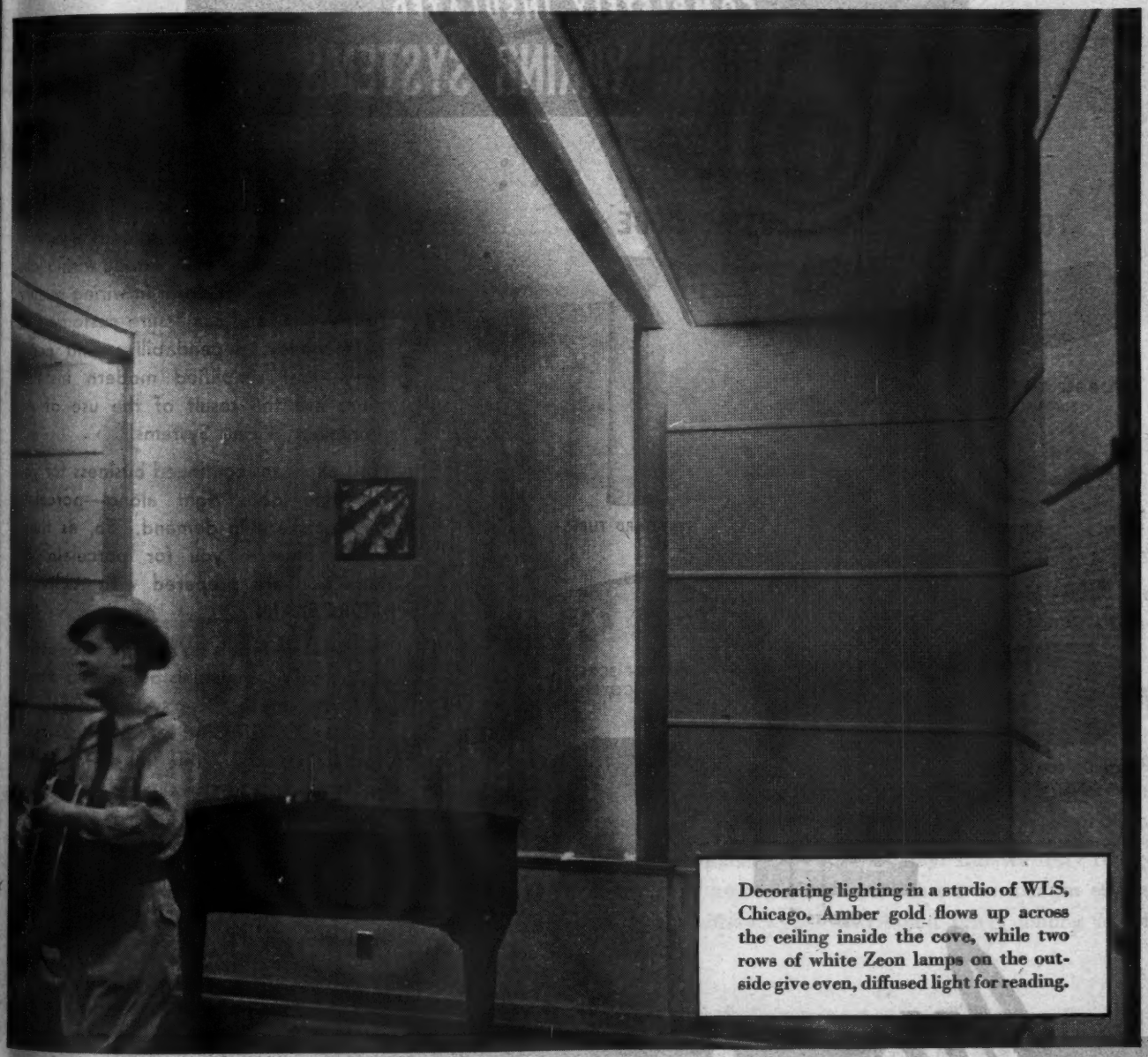
As a leader in the manufacture of gaseous discharge tubular lamps for 15 years, Federal Electric Company, Inc. and its engineers have solved thousands of lighting problems. They know how to secure the most efficient lighting at minimum cost. They also know what not to do, and can help users avoid mistakes which might prove disappointing and costly.

To make this help available to more prospective users than its engineers could possibly reach personally, the company now offers "Lighting Information Service." You, your architect, engineer, or contractor, are invited to submit your lighting problem on the form below, or in a detailed letter if you wish. Our engineering staff will make a sincere effort to give you the best possible solution to your problem.

ZEON COLD CATHODE

There are 2 kinds of fluorescent lighting

"Hot Cathode" is the common heater filament type of fluorescent lighting; "Cold Cathode" is the improved, shell electrode type, of which Zeon is the outstanding example. Long life, lower maintenance cost, and greater flexibility are distinguishing features.



Decorating lighting in a studio of WLS, Chicago. Amber gold flows up across the ceiling inside the cove, while two rows of white Zeon lamps on the outside give even, diffused light for reading.

FEDERAL ELECTRIC COMPANY, INC. LIGHTING DIVISION

8700 S. STATE ST., CHICAGO 19, ILL. TELEPHONE VINCENNES 5300

225 N. MICHIGAN AVE., CHICAGO 1, ILL. TELEPHONE STATE 0488

SUBSIDIARY COMPANY . . . FEDERAL BRILLIANT COMPANY, ST. LOUIS, MO

MEET THE DEMAND WITH ILLINOIS

COMPLETELY INSULATED

ALL PORCELAIN WIRING SYSTEMS . . .

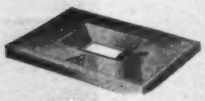
PORCELAIN CONFORMS TO THE NATIONAL ELECTRIC CODE

TOGGLE SWITCH PLATE

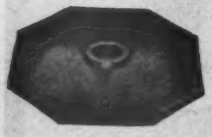
Look for this Trade Mark

STANDARD TUBES

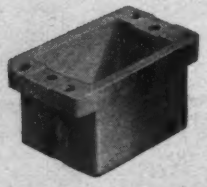
STANDARD KNOBS

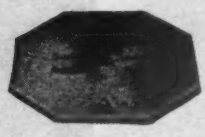


SWITCH BOXES AND COVERS



OUTLET BOXES AND COVERS





DUPLEX RECEPTACLE COVER

CLEATS

★ Contractors everywhere know that Porcelain in large quantities is available —that, therefore, they can do wiring jobs today with no let down in wiring quality —that they still can assure customers of permanency, dependability, and economy—that simplified modern installations are the result of the use of All Porcelain Wiring Systems.

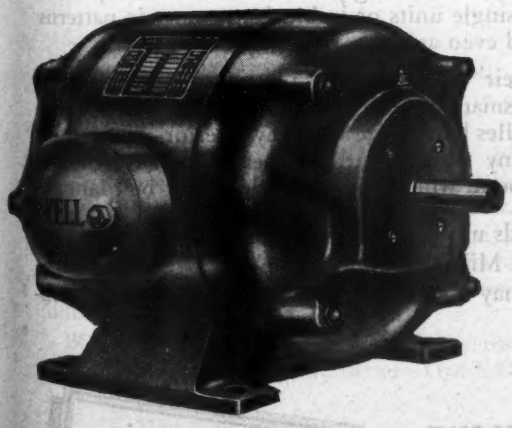
This all means continued business for you —wiring goes right along—porcelain products are in demand. So, as those calls come to you for porcelain, be sure you are prepared with ILLINOIS PORCELAIN.

No vital materials go into the production of porcelain, materials do go into porcelain that make these systems durable—that are not affected by rust or corrosion —that make possible full safety—that make these systems valuable where there is dampness and fire hazard.

Illinois all porcelain wiring systems are adaptable to practically all wiring plans and layouts. They can be installed without grounding.

Illinois ELECTRIC PORCELAIN CO.

MACOMB, ILLINOIS



The Howell Protected Type Motor, shown, gives complete protection against dripping liquids, metal chips and other falling particles. Completely streamlined—utilizing non-breakable steel frame—malleable or steel base—cast iron end plates and cast iron, weatherproof terminal box are standard construction features. Special horizontal and vertical mountings are available.

Available in sizes 5 Hp. and smaller. Other sizes and types available up to 150 Hp.

Now, while the delivery situation in the entire motor industry is serious, the arrival of a new Howell Motor gives double satisfaction.

First, you get the satisfaction of receiving a better performing motor.

Second, you know that it will give you better service, because we have rigidly adhered to our policy of maintaining prewar standards and have steadfastly refused to compromise in quality.

Sure, we are swamped with orders today! But we fully recognize our obligations and are putting forth our maximum efforts to see that Howell Motors are distributed fairly among all of our customers.

Buy Horsepower by

HOWELL ELECTRIC MOTORS COMPANY

HOWELL, MICHIGAN

Manufacturers of Quality Motors Since 1915

More Light on the TRUE cost of FLUORESCENT LIGHTING

in stores, offices, schools and public buildings

THERE is but one way to "figure" *any* lighting system: The *total* cost, fully installed and ready to operate.

"Fixture" cost is but part of the total cost. Unless the *composite* costs of conduit, wire, wiring and other installation and mounting materials are also taken into full account, the *true* cost may be a sad surprise.

In designing fluorescent lighting systems, The Miller Company has done something about that fundamental point:

1. The number of supports needed to hang Miller lighting equipment has been reduced 50 to 75%.
2. Moving of outlets has been minimized or, in many cases, *eliminated.*
3. Wiring costs have been reduced up to 50%.
4. Conduit and conduit fitting costs have been reduced up to 80%.
5. *New ceiling furring systems, made possible by the patented Miller Bracket, provides a stronger structural ceiling, simplifies and speeds up the entire construction.*

To the foregoing brass tacks, add these facts:

1. Miller Fluorescent Lighting Systems are backed by 100 years' experience with all proven light sources.
2. These systems present new vistas in esthetic design and functional planning.
3. They are amazingly versatile and fit the picture as single units or in blocks, geometric patterns and even as light strips "by the mile".
4. Their wide range of plastic and glass plates, prismatic glass lenses and metal or plastic grilles harmonize with any interior—or, in their many possible arrangements, suggest themes around which entire interiors may be planned.

It all adds up to the simple GRAND total fact that calling a Miller Representative (they're in principal cities) may be your happy answer to a lot of problems!

THE MILLER COMPANY • MERIDEN, CONNECTICUT

MILLER SINCE 1844

ILLUMINATING DIVISION
Fluorescent, Incandescent
Mercury Lighting Equipment

OIL GOODS DIVISION
Domestic Oil Burners
and Liquid Fuel Devices

ROLLING MILL DIVISION
Phosphor Bronze and Brass
in Sheets, Strips and Rolls

WAR CONTRACTS DIVISION
War Materiel

Know-how!

BULLDOG BUStribution DUCT

MANUFACTURERS, large and small, turn to BullDog for the real "know-how" in electrical distribution.

This is only natural, for BullDog pioneered plug-in power and lighting systems, and has introduced every important new improvement.

Three modern BullDog DUCT systems, the most widely used in industry, provide complete versatility and flexibility of power and light for every type of industrial application.

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REDEDICATION

An Obligation to Our Fighting Men

DURING the last few weeks we have been forcibly reminded that so long as we still are fighting either of our major foes, first claim upon the productive resources of the United States—its manpower, materials, utilities, and industrial facilities—must be the production and delivery of munitions and war supplies. All other claims are secondary. No responsible citizen would have it otherwise. For in this war even more is at stake than our existence as a Nation. We dare not forget that we are engaged in a struggle that challenges the fundamental values upon which our civilization has been built.

It is not easy to list the values that we are fighting to uphold. They have been clothed in a variety of shapes over the centuries. They will assume new forms in the years ahead. But they have an inner consistency that free men the world over can feel and recognize: the right of the commoner against the noble, the right of the individual against the state, the right of trial by jury, the right to vote, the right to an education, the right to freedom of speech and worship, the right to work in a sphere of one's own choosing, the dignity and the equality of the individual under the law—these are our cultural heritage, painfully won and often precariously held over the ages, always to be rewon, redefined and buttressed by each succeeding generation of men.

The preservation of this vital core of value, and its transmission to our sons and daughters depends upon our victory in this struggle. So those things which are essential to victory must come first. And since the production of war munitions in overwhelming volume and quality can hasten that victory and save countless lives of our fighting men, no effort that will contribute to this end should be regarded by us as a sacrifice.

☆ ☆ ☆

The present is no time for self-congratulation upon our achievements either in the theatres of battle or of production. The mounting casualty lists should suffice to curdle the savor of any such indulgence. The most that can be said in reasonable taste and good conscience is that performance in both fields is such as to warrant our firm confidence that we can carry to successful completion the tasks that remain to be done.

Nor is there profit in even observing, much less deploring, that the tasks ahead are more formidable than those which were defined for us a few short months ago. Then, all of us—military leaders, government officials, workers, and business men—were riding a crest of optimism as to an early end of the war in Europe and as to the character and dimension of the war against Japan. Already we had begun to turn anxiously toward the problems of reconversion which then seemed so near at hand. Schedules for war production, based upon the best available estimates of need, called for a 5 billion dollar reduction from 1944 performance, even though we might have to continue a two-theatre war, and for a 40 percent reduction in the event of an early victory in Europe.

Today, those forward estimates have been revised sharply upward. That is true both of the 1945 requirements to meet the needs of a two-theatre war, and of requirements for the Pacific war once the European phase is ended. For this upward revision four chief reasons are responsible:

1. European battle experience has shown markedly greater use of expendable munitions than was provided in the formulae upon which our original production schedules were calculated: the result has been a depletion of inventories on a scale that would become dangerous if allowed to continue.
2. Experience has also demonstrated the need for new types of weapons or increased complements of some existing types to match new enemy equipment or tactics.
3. A less easy optimism as to the early ending of the European war has given rise to a growing disinclination to gamble on the approximate date.
4. An increasing conviction prevails that the war against Japan may require ground-army operations on the Asiatic mainland on a scale greater than originally premised.

But if these changes in the fortunes and outlook of war have raised our estimates of military requirements, may not subsequent favorable changes in the military situation cause them again to be revised downward? It is entirely possible. But our military men have learned that they cannot safely discount what *might desirably happen* as something that *will happen.* Those working on the production front also must learn that lesson. Fortunately, the record shows that we have been able to maintain a war production almost equal to that of the rest of the world combined, even while we produced for civilian use on a scale that has been large even by our

own pre-war standards. So we have ample margin to whip whatever war job may be required of us. As now defined, the task will not be easy. But it *can* and *will* be done.

☆ ☆ ☆

What, then, is the production task with which we are charged? Our 1945 production for the two-theatre war now calls for the substantial maintenance of the over-all levels reached in the latter months of 1944. But there is a shift of emphasis. Almost half of the programs for specific equipment items are declining. A few are scheduled to hold level. About 45 percent are scheduled to rise sharply. That means that workers and facilities must be shifted to man the expanding programs. At the same time the armed services are calling for many more men than can be supplied from those who become newly eligible to the 18 year old age group. That means further drafts upon war workers. It means also replacements for them when they are taken from the expanding programs. Finally, events demand that we produce as much as possible of many items during the first half of 1945.

Our task, then, is one of intensified effort for the immediate future, with multiple readjustments at a stage when adjustments are hard to make. Materials for which demand was easing as pipe-lines were being drained in anticipation of falling schedules again are tight as the pipe-lines are being refilled to meet augmented requirements. Men, women, and facilities must be shifted from less essential to more essential tasks. What must be done will be done. But unless there is much voluntary accommodation, it will be necessary for us to suffer a formidable amount of governmental direction which none of us likes, many of us deeply resent, and all of us, when personally affected, volubly protest. The more we police ourselves, the less we shall be policed.

☆ ☆ ☆

Even after Germany has been defeated, we shall still face a far from light production requirement to continue the war against Japan. As currently defined this phase might require war expenditures at something like $70 billions a year, an over-all reduction of approximately 20 percent from the $89 billions spent in 1944. Reduction in munitions output would be somewhat greater, probably from 25 percent to 30 percent below 1944 levels. But it is important for us to acknowledge that the reduction is going to be substantially less than the 40 percent previously estimated.

Only a few months ago there were those who questioned sharply the possibility that we might need 60 percent of current munitions output to win the Japanese war. Now the judgment of the military is that 70 percent will be none too high.

Actually the latter level would represent an increase of little more than 50 percent above what now is being produced for the Pacific area. This, certainly, is a modest estimate when we reflect that we shall inevitably more than triple the Army forces assigned to that theatre.

Such a program probably would give us a current munitions supply from three to four times that produced by Japan, but it is believed that we shall need that much to compensate for the advantages derived by Japan from the fact that she will be fighting a defensive war, from the volume of her accumulated stores, from her prepared positions, her shorter lines of supply and transport, and from her large troop reserves, the bulk of which we have yet to meet in battle. Certainly our present 3 to 1 production edge over Germany does not appear to be excessive.

The more modest V-E Day cuts contemplated by the present plan will mean a less acute reconversion problem when they are made, but will leave a greater one to be met at the end of the war. They will mean probably a net increase of not more than 4 million workers available for civilian work during the transition period. Their orderly absorption should present no embarrassing problem. Indeed, we now are warned by Washington that war production following V-E Day may require the protection of considerably closer control than was contemplated under the 40 percent cuts previously expected.

☆ ☆ ☆

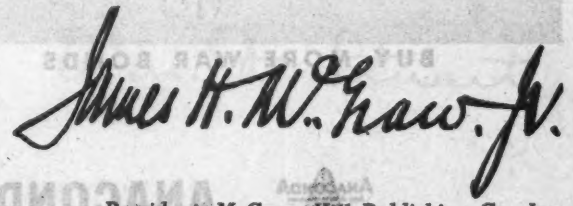
In short, we face for the immediate future a more difficult production job. It is made the more formidable by the fact that we had dulled the keen edge of our will to produce by our premature expectation of a reduction in requirements. Now we are told that the trend of war production for the immediate future is up, that it is unsafe to discount the date of victory in Europe, and that the amount of leeway for reconversion after the defeat of Germany is less than had been anticipated.

Accordingly, we must rededicate ourselves to the task of driving war production up. We must do without some of the things that we have enjoyed on the civilian front rather than demand more of those things; we have still to devote our abilities and energies first and foremost to the demands of war.

Whatever will assure and hasten victory must have first place in any statement of American policy.

Without victory, our aims, and the underlying values upon which they are based, will be extinguished, blotted out by the opposing aims and values proclaimed by our enemies.

The needs of our fighting men must be put first. For, unless we win the war, the National aims and policies of the United States will cease to have meaning in the world.



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NEW HORIZONS

A study of what electrical men look to as vital postwar industry problems turns up some excellent ideas. There is, we find, much serious thought going on about standards, new materials and methods, labor relations and other broad industry problems. Many are turning their attention to promotional campaigns and efforts to get the industry to speak out with a common voice about adequate wiring. A few see specialized fields such as electronics deserving intensive education and promotion.

In the main, however, most unorganized planning evidently deals with *current* internal problems extended into the new era. And the extension inevitably carries with it the economic environment of the present, the scarcities in materials and manpower, the dilution of skill and of quality that comes with inflated payrolls and "bare bones" restrictions upon manufacturers.

But are the real postwar problems of our industry internal? Must we, for instance, devote our best thinking exclusively to devising labor-management machinery for establishing realistic wage, hour and working conditions, rules and formulas? This is important but hardly a *postwar* program. The machinery is already available. The cooperative spirit has been tested and proven time and again. Refinement and improvement will come.

Or should we devote our efforts solely to stronger and better wiring standards? Again we may question whether this is a *postwar* job. It deserves attention. It must be done with our eyes ahead to the days after the war. But the machinery of code making is available. There are standards which can be improved and strengthened—and will be.

No! Our greater postwar objectives must be aimed at new horizons. Important as current problems of labor relations, code improvements or material distribution are, they ought to be subordinate. The opportunities ahead, if we are willing to accept new goals, cannot wait for ideal internal conditions in the industry.

What are some of these opportunities? Electronics is one. Electronic apparatus developed during the war can enter industry, the office building or the home as a specialty, developed, sold, installed and serviced by some new commercial organism. Such apparatus can also move rapidly and extensively into public use as conventional electrical equipment through already organized electrical distribution channels, sold, installed, and serviced by electrical contractors. Here is a new horizon. What are we ready to do about it?

America can be relighted in ten years. Ignoring for the moment the market for modern illumination in new postwar buildings, the possibilities for relighting alone are just about what we are willing to make them —another new horizon. What are we ready to do about it?

And then there is adequate wiring—the ability of the inventor and merchandiser to create and sell new electrical apparatus for attachment to electrical wiring has consistently outstripped our best efforts to sell and install the all-essential means to bring enough energy to convenient points of use. This is no reflection on our materials, workmanship, labor policies or distribution methods. It is, however, a serious indictment of our planning and business foresight. Wiring needs new horizons.

Our postwar plans can be anchored to the very real and very important internal problems of today. Or they can seek out the opportunities of tomorrow. Our new horizons are exactly what we are willing to make them.

Wm. H. Stuart

SUPPORT for your judgment

Mr. Electrical Contractor

In 1945, Graybar is continuing its "John Watts" advertising campaign addressed to architects and builders in the pages of "The Architectural Forum". Its primary purpose is to give the architect a better appreciation of the qualifications and services of the electrical contractor. As in the past, it urges him to work closely with John Watts and to consult him early. *Graybar Electric Company.*

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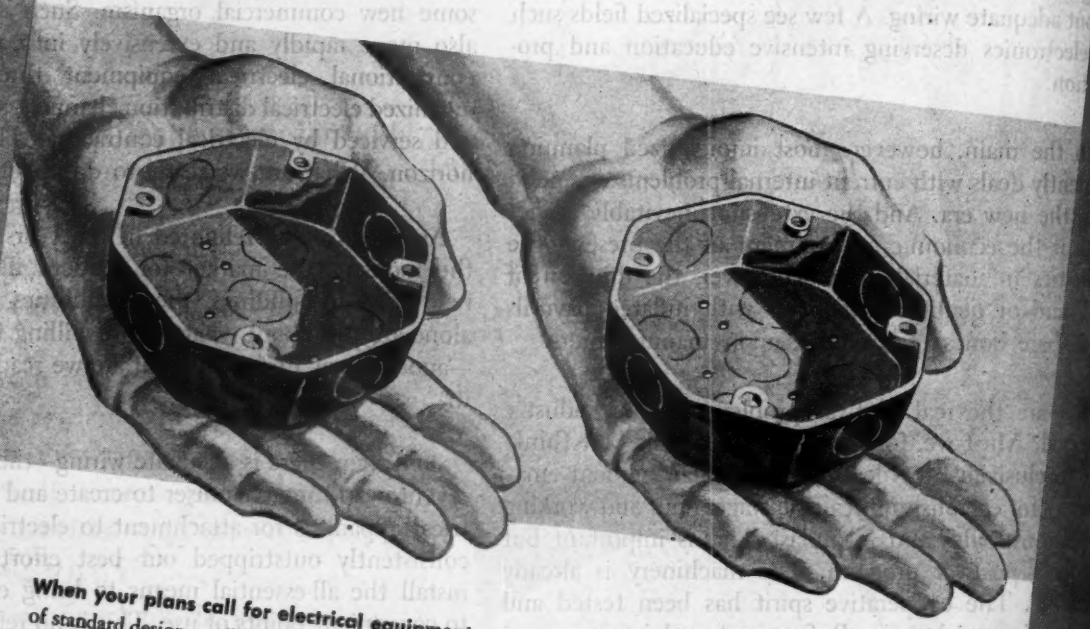
Ask John Watts Electrical Contractor to tell you the difference



When your plans call for electrical equipment of standard design, you'll do well to look behind the *external similarity* of items of a different origin. Installations savings, as well as extra service life, often result from quality factors that don't show up in the "specs".

To tell the difference, it takes a man with everyday experience in dealing with these units . . . a man who knows which outlet box has the cleaner knock-outs, the heavier galvanizing, the more accurate fits.

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All over the country, leading electrical contractors help keep themselves well informed and equipped "via Graybar". You can depend on the contractor who buys from Graybar for sound, first-quality wiring materials.

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Give Your Electrical Work to "John Watts" a qualified electrical contractor — heading a well-established firm with the trained organization, tools and know-how to give you specialized assistance on wiring, lighting, signaling, power supply, electronics. From offices and warehouses in over 80 cities, GRAYBAR serves a nation of JOHN WATTS, helping them to help you by supplying the newest and best in electrical materials.

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Everything Electrical GraybaR

ALTERNATE WIRING — THE KEY TO THE HOME OF TOMORROW

HANDLING 10,000 MOTORS A YEAR

The Reed plant in Los Angeles never closes its doors. Planned work flow and methodical layout make high volume production possible.

SINGLE PHASE DEPARTMENT. This department has its own dip tank, oven, lathe, dynamometer and all necessary equipment to operate as a separate department

By H. W. Young

IN its present location since 1935, and for one year preceding that in another location, the motor repair plant of the R. A. Reed Electric Company of Los Angeles holds something of a record in that during all the nine years it has never closed its doors. In fact, the receiving department has no door. Work has continued on three shifts, 24 hours a day, including Saturdays, Sundays and holidays, year in and year out. At present, there are 85 shop employees, with an executive and office force of nine.

About 850 motors are rebuilt per month, ranging from fractional hp. to the largest they have ever rebuilt—a 1500 hp., 16-pole, main drive motor for a steel mill. The quality of work performed and the fast service which can be rendered because of the large, well-laid-out plant operating continuously seven days a week, with the most modern equipment and production methods, has resulted in a steady growth in volume of work done all through the depression years as well as during the war period.

While there is a transformer repair department that is growing in importance, at this time 80 percent of the total business is in motor rebuilding. The layout of the motor section of the plant

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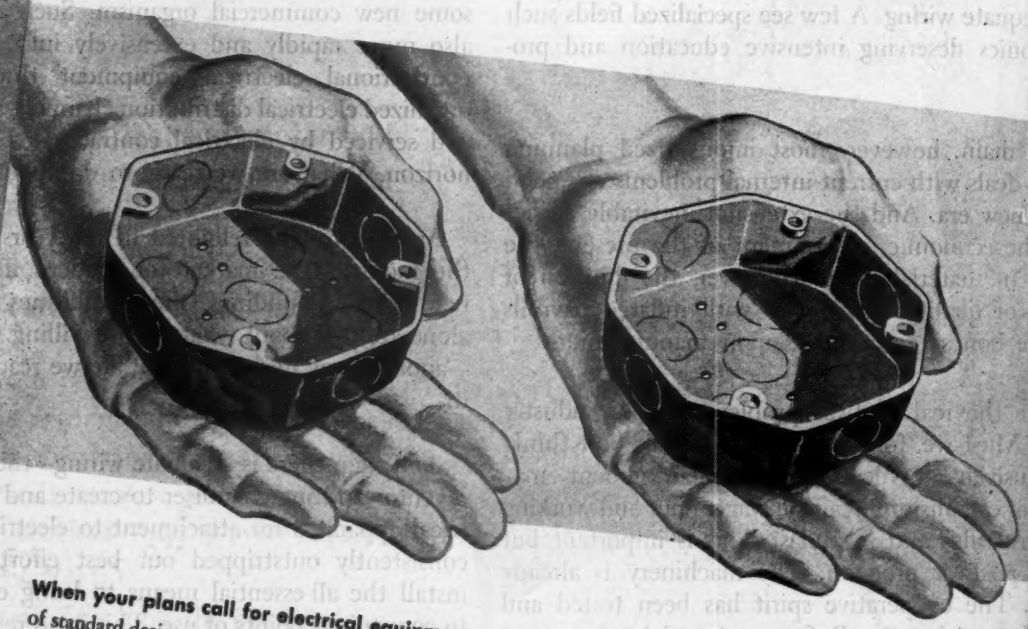

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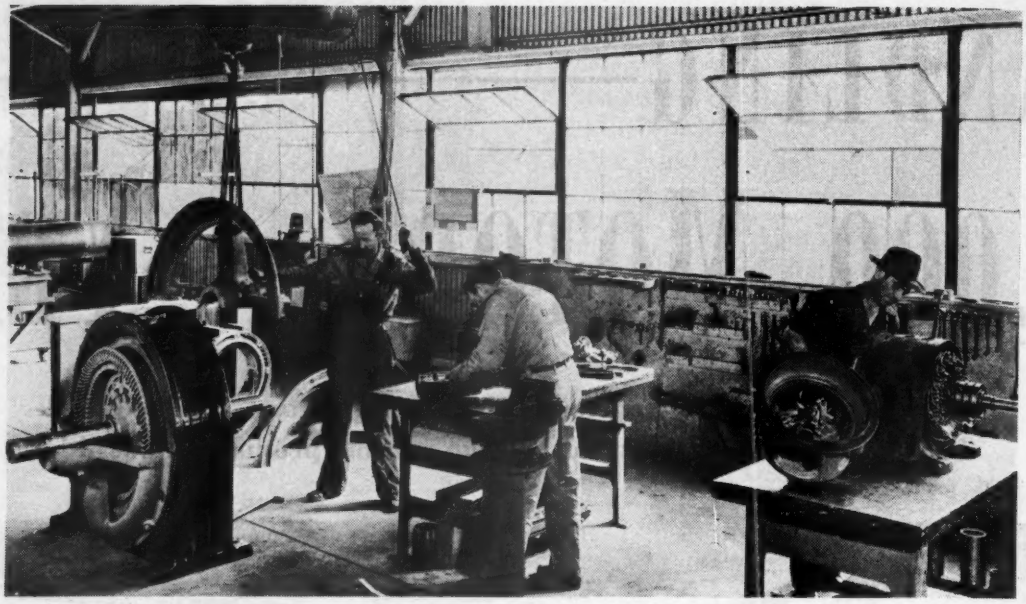


POWER HOISTS, POWER TOOLS, bench heights to fit worker and tools of every description makes assembly work easy and simple.

and the routine by which the work passes through the plant, from receiving platform to shipping platform, are especially interesting. An effort has, therefore, been made to show this routine, as far as the motor shop is concerned, on the accompanying floor plan of the building, rather than in the form of a continuous flow-sheet. The transformer section, though indicated, is not specifically treated in this way.

In doing the work, emphasis is laid particularly on two things in this plant. (1) a rebuilt motor must not only perform like a new motor but it must also have the appearance of a new one as far as mechanical work and finish are concerned. Steam cleaning and sand blasting operations, machining and painting are all done to factory standards, so that the customer feels that he is getting a new machine, and to all intents and purposes it is.

(2) It has been the aim of the management in every way possible to use power in handling all heavy parts and assemblies, and to so adjust working heights that stooping is unnecessary. All the building areas are served by traveling hoists, with push-button control. Between buildings, transfer where necessary is made from hoist to hoist by car.

Major equipment in the motor winding department includes:

5 winding lathes
1 air-operated coil spreader
2 hand-operated coil spreaders
4 taping machines

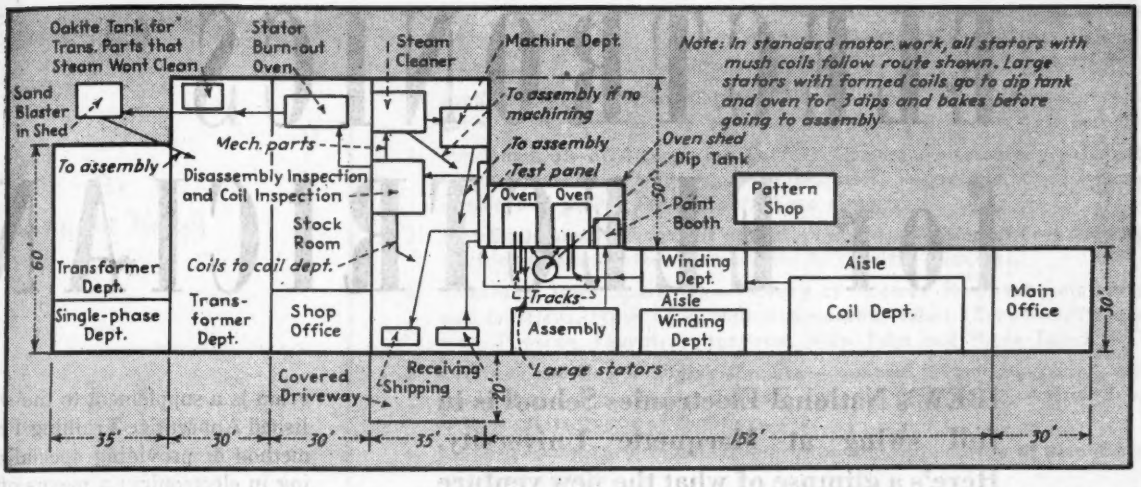
A special pattern shop is maintained in a detached building, with a full complement of wood-working tools for making special forms for coils. Electric and air-operated small tools and accessory equipment are used everywhere they will facilitate the work and make it "easy and simple", which are the watchwords.

R. A. Reed is the principal partner in the Los Angeles plant. He also owns outright the Reed Electric Company of Portland, Ore., a small shop using the same methods which have proved so successful at the Los Angeles shop described in this article.

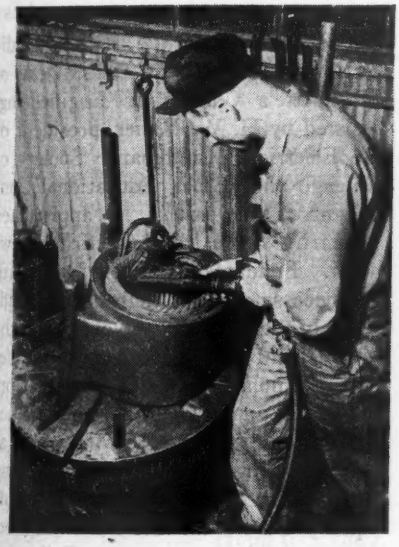
Associated with Mr. Reed at Los Angeles are George Larsen, chief engineer and plant superintendent, and W. M. Hogue, business manager.

METAL SPRAY equipment which is used to build up shafts is located in the mechanical department.

GROUP-WOUND COILS are taped quickly and easily by automatic taping machines such as this.



***PLAN OF MOTOR-REBUILD AND TRANSFORMER DEPARTMENTS** of the R. A. Reed Electric Company, Los Angeles. The flow of work in standard motor-rebuild operations is indicated by arrows.*



***COIL ENDS** are first cut by air-operated tools.*

***BURN OUT FURNACE,** stator stripping and cleaning operations are performed in this corner of the shop.*

***AIR-OPERATED SPREADER** for forming wound coils.*

***OPERATOR WEARS GOGGLES** and stands behind partition in performing the sand-blast operation for cleaning motors.*

ELECTRONICS for ELECTRICIANS

IBEW's National Electronics School is in full swing at Marquette University. Here's a glimpse of what the new venture involves and how the students are weathering it.

LAST December 2, some 70 journeymen electricians bade farewell to Marquette University's College of Engineering in Milwaukee and returned to their respective homes in more than half of the 48 states. They were the first graduates of the International Brotherhood of Electrical Workers' National Electronics School.

This hand-picked, thoroughly screened, group of men were the first to be sent to Marquette to take a six-weeks, accelerated course in practical industrial electronics—the initial step in the International Union's broad plan to provide its members with the basic fundamentals of the science that bids well to be one of the most revolutionary factors in the electrical industry.

While these graduates are at home setting up Local Union electronics schools, 81 other top-flight journeymen from throughout the country are busy at Marquette cracking the books for the same course. And advance registrations for the remaining six terms are being over-subscribed.

By establishing and endowing this unique college course—one of the first to embody the active cooperation of labor, management, the university, and industry—IBEW hopes to train more than 600 journeymen who, in turn, will instruct one or more classes of 25 to 30 electricians in their own Local Unions using the well known Westinghouse Course "Electronics at Work" as part of the basic curriculum. The whole program is a supplement to the well established Apprentice Training Program; a method of providing specialized training in electronics; a means of enabling Electrical Workers ". . . to progress with the development of the industry," as IBEW President E. J. Brown commented in announcing this new educational experiment.

The course of study, under the direction of William D. Bliss, Dean of Marquette's College of Engineering, assisted by H. W. Maher, president of the Electrical Maintenance Society of Chicago and IBEW Educational Consultant at the school, is approached primarily from the practical viewpoint. Fundamental theory and math are necessary for a thorough groundwork in the principles involved, but the "heavy stuff" is bypassed to a large degree. Emphasis is on the installation, operation, application and maintenance of electronic equipment in industry (as can be seen from the accompanying curriculum) with the course schedule equally divided between classroom lectures and laboratory work. Following

THE FACULTY

Dean William D. Bliss, *Marquette — Director*

Professor Edwin L. Cordes, *Marquette*
Professor Edward W. Kane, *Marquette*
H. W. Maher, I.B.E.W. — *Educational Consultant*
John Daly, I.B.E.W. — Registrar

INDUSTRIAL LECTURERS

General Electric Company
Tracy Johntz
William Frackelton
Ralph Welton
George M. Chute
Ralph R. Johnson
W. J. Piney
Harold E. Larson
George W. Spellmire

Westinghouse Electric & Mfg. Co.
Chester Emery
Byron Hill
R. V. Ross
P. T. La Hue
R. S. Moore
Glen Paden
Amos Germaine
B. C. McDonnell
J. H. Terhorst

Allis-Chalmers Mfg. Co.
Walther Richter
W. E. Gutzwiller
J. M. Cage
H. C. Dustman

Wisconsin Electric Power Co.
C. D. Brown

THE TERMS

1st Term	Nov. 13—Dec. 23, 1944	5th Term	May 14—June 23, 1945
2nd Term	Jan. 8—Feb. 17, 1945	6th Term	June 25—Aug. 4, 1945
3rd Term	Feb. 19—Mar. 31, 1945	7th Term	Aug. 6—Sept. 15, 1945
4th Term	April 2—May 12, 1945	8th Term	Sept. 17—Oct. 27, 1945

By
August Eckel

the "visual education" pattern of the accelerated Armed Forces Training Program, lecture-demonstrations, slides, and the movies are used extensively.

Two Marquette electrical engineering professors, Edwin L. Cordes and Edward W. Kane are handling the teaching assignments in the classroom and lab using W. D. Cockerell's "Industrial Electronic Control", G. M. Chute's "Electronic Control of Resistance Welding," and N. M. Cooke's "Mathematics for Electricians and Radiomen" (fundamentals of math up through vector algebra) as textbook guides. Assisting the faculty by lecturing on industrial electronic equipment operation and application are 22 expert engineers assigned by the Allis-Chalmers Manufacturing Company, General Electric Company and the Westinghouse Electric and Manufacturing Company. Generous supplies of technical literature from these cooperating companies augment the textbook material.

The students in this group took their theory seriously. Outstanding examples: The pertinent questions (encouraged by the professors) asked in the classroom to clear up vague points; the after-dinner trek of a group of eight men to the University of Wisconsin Extension School to hear Allis-Chalmers' renowned Walther Richter talk on "space charge"—after listening to him lecture on oscilloscopes for some seven hours that very same day in the classroom; the daily nocturnal "academic bull sessions" in the rooms of near-campus hotels where the men assembled in small groups to discuss the day's studies, or bone up on some perplexing points, or help out the man who might be somewhat confused. Tentatively two to three-hour study periods, these sessions often continued into the wee hours of the morning.

Being of a practical nature, however, the men were happiest when in the laboratory where they actually got the "feel" of electronics—saw the "innards" of the electron tube, connected the circuits, watched the tubes function, performed experiments, worked on everything from a small photo-tube to an industrial X-Ray unit, and actually built certain equipment. Not content with the regular prescribed laboratory sessions and experiments, the group requested—and was granted—permission to use the labs "after hours" and to build, from component parts, electronic time delay relays, oscilloscopes, and other devices.

Attending class six days a week from 9:00 a.m. to 5:00 p.m. the men assembled the "bibles" of the course—their notebooks filled with classroom lecture and laboratory notes, experiment sheets, and a generous supply of manufacturers' literature on the equipment they are going to install and service in the future. These, plus the textbooks, form the foundation of their personal library on electronics.

Not listed in the formal curriculum but added as an informal feature was a session on public speaking. Twice a week at a one-hour, after-class session, three-minute talks on pre-assigned subjects were delivered by various journeymen before the assembled group. Speaking extemporaneously from notes—canned speeches were tabu—they got the feel of thinking on their feet; of putting across a subject so their audience could understand it; of answering spot questions and presenting clear-cut explanations. This training, coupled with the constructive criticism from the floor, prepared the men for one of their prime home-coming tasks—conducting and instructing local electronics classes.

WHAT THE COURSE COVERS

1. **Fundamentals of Direct Current Circuits—units of measurement, circuits, power, magnetism, batteries, motors, generators, instruments.**
2. **Fundamentals of Alternating Current Circuits—elementary principle of a.c. generator, frequency, transformers, impedance, capacitance, power and power factor, polyphase circuits.**
3. **Test Equipment—theory of operation and application of Cathode Ray Oscilloscope and other instruments to specific problems.**
4. **Electronic Tube Operation—theory of electron flow, tube elements and functions, types of vacuum and gaseous tubes (Kenotron, Phanotron, Pliotron, Thyratron, Ignitron, Glow Tube and Photo Tube).**
5. **Rectifier and Power Supply Circuits—general theory, operation and application of rectifying devices, full and half-wave rectification, filter circuits, types of rectifiers, etc.**
6. **Amplifiers—theory, function, operation and application of amplifiers and their circuits.**
7. **Oscillators—theory, function, operation and application of oscillators and their circuits.**
8. **Photo-electric Tubes—historical background and theory of light-sensitive tubes of all types, their operation and application in industry.**
9. **Electronic Timers and Relays—theory of operation and application of electronic timers and time relays in industry, simple and standard circuits, time constant.**
10. **Phase Shift Circuits—theory and function of phase shifting and a study of circuits involved.**
11. **G. E. Reactrol System—a study of the function of this system and its various industrial applications, comparison with other temperature control methods, study of the circuits, study of thermocouples and their use.**
12. **Thymotrol and Mototrol—a study of the operation and application of these electronic motor control systems.**
13. **Resistance Welding—a study of resistance heat welding, equipment, circuits, saturable reactor, peaking transformers, phase shift, firing time control, application in industry.**
14. **Induction and Dielectric Heating—theory, operation and application of both types of heating in industry, equipment, circuits, power sources.**
15. **The Precipitron—theory of operation and application, basic schemes used, derivation of expanded systems.**
16. **Amplidyne Equipment—installation, maintenance, operation and application.**
17. **Industrial X-Ray Equipment—installation, maintenance, operation and application.**

ADMINISTRATORS of the new project are William D. Bliss (left), Dean of Marquette University's College of Engineering and H. W. Maher, Chicago, IBEW Educational Consultant.

UNDER WATCHFUL EYE of Prof. E. W. Kane (left), Jim Fewell, Lawton, Okla., tackles connections on a 150 kv. industrial X-Ray control in the lab. John Maser, Detroit, looks on.

Another added feature—visits to near-by industrial plants—gave the men a broader appreciation of electronic application opportunities and problems; a chance to talk over installation, operation and maintenance; a general picture of the end-use to which their training is directed.

As a group, the journeymen were a unique college class. Serious-minded, they went about their studies with a grim determination to absorb every possible bit of knowledge within the short time allotted. They seemed eager to take full advantage of the opportunity offered them—a basic education in electronics, gratis. Their tuition was paid by the International office; their wages, travel and living expenses either by their local union or their employers, or—as in a few cases—travel and living costs by the individuals themselves. They went home with an intangible asset that cannot be valued in precise dollars and cents—education; with the satisfaction that an investment—financial for their sponsors, time for them—was well made and that the dividends would be forthcoming.

From the standpoint of background, experience and geographical location, the first graduates presented an interesting study. Although a good portion of the group had college or vocational school training before, many of them had not been in a classroom for 20 to 30 years. All were old in experience—many of them in years. With the average age of the group about 45 years—the oldest 63, the youngest 25—they proved the old adage "It's never too late to learn." It was a tough grind for some but none gave in. They stuck it out and made the grade.

A preliminary survey of the initial registration for the first term indicated that of the 70 journeymen present: 32 had some college training—a few possessing degrees; 30 had high school or vocational school training, 26 had teaching experience of some type; 14 had experience with radio work; 12 had electrical maintenance experience; 22 worked in the electrical construction field at one time or another; only six had experience in industrial electronics. All plan to use this knowledge to the best advantage—to themselves and to the industry.

Oldest student was B. J. Reynolds, 63, of Newport, Rhode Island. Before joining the Navy back in 1903, Ben was a lineman. One of the first radio men in the service, he ended his Naval career by retirement in 1923. He continued in the electrical field and is now engaged in war work. Ben expects to use his Marquette-acquired background in good stead in his work and to teach his brother journeymen electronics at night.

Youngest registrant, Raymon Roberts, 25, of Richmond, Va., has been working for electrical contractors since his graduation from high school seven years ago. Raymon is taking his newly acquired electronics knowledge back to the contractor's shop and will teach other electricians at night.

For 27 years, Herbert Lamey of Evansville, Ind., has been working in the electrical contracting field. Using the basic fundamentals learned at Marquette, he intends to follow through on his study of electronics—specializing in electronic control and resistance welding. At night he will instruct a local union electronics class.

Gilbert A. Blackwood is a college graduate who teaches electricity at the Muncie, Indiana, Trade School. He takes back with him an additional store of electronic knowledge which he will impart to his Trade School students as well as his local union class.

Robert T. Seiden, Tampa, Fla., is in charge of electrical maintenance for a manufacturing plant in that city. With his newly acquired electronic knowledge he will be in a position to suggest applications to improve plant efficiency; to install and maintain such equipment; to teach others the fundamentals as he plans to do in his local union sessions.

From San Diego, Calif., came Paul E. Roosenberg who, for the past eight years has been with the San Diego Gas & Electric Company—now is a relay tester. Paul started his electrical career with a contractor doing maintenance work. He is going back to his job and conduct his local union classes at night.

Out in Lawton, Oklahoma, Jim Fewell—with 3½ years of college work to his credit—has, for the past eight years, been shop foreman and estimator for an electrical contractor; W. R. Crosland of Fort Smith, Arkansas has been in the electrical construction field for 18 years; W. H. Collins, Flint, Mich.—a college graduate and radio "ham" for 30 years—is working with contractors; J. M. Wallace, Pittsburgh, Pa.—an electrical engineering graduate—is in the electrical construction and telephone fields; H. A. Smith of Midvale, Utah is in electrical construction and maintenance; William Cullen, Cincinnati, Ohio, is an ex-

[Continued on page 182]

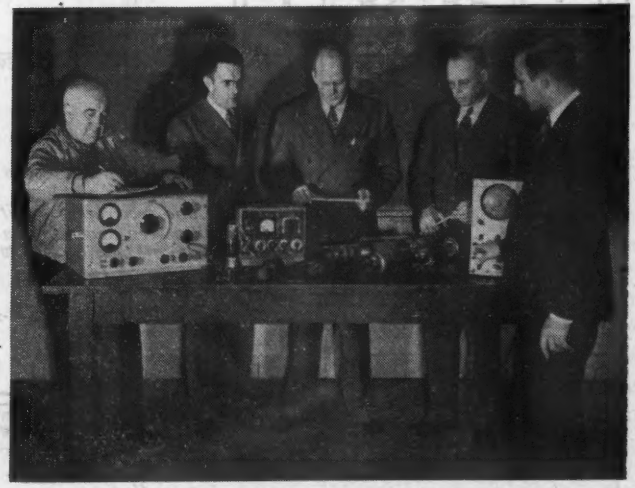
PROF. E. L. CORDES, electrical engineering professor at Marquette points out the high spots of the laboratory Ignitron installation to I. M. Jones (left), Goose Creek, Texas; and B. T. Doughty, New York City.

WHAT MAKES IT TICK?—W. H. Collins (left), Flint, Mich., gets the "inside story" on an industrial radio-frequency generator for induction and dielectric heating from Prof. E. W. Kane in the Marquette labs.

THE ANSWER IS . . . speculate (L to R) E. L. Masters, Gallup, N. M.; and J. W. Jones, Albuquerque, N. M., as P. E. Roosenberg, San Diego, Calif., works it out on the slide rule during a lab session.

TYPICAL AFTER-DINNER boning-up session. Here (L to R) J. M. Wallace, Pittsburgh, Pa.; M. L. Batchelder, Columbia, S. C.; M. E. Stuart, Columbus, Ga.; and J. F. Baer, Reading, Pa., study circuits and math.

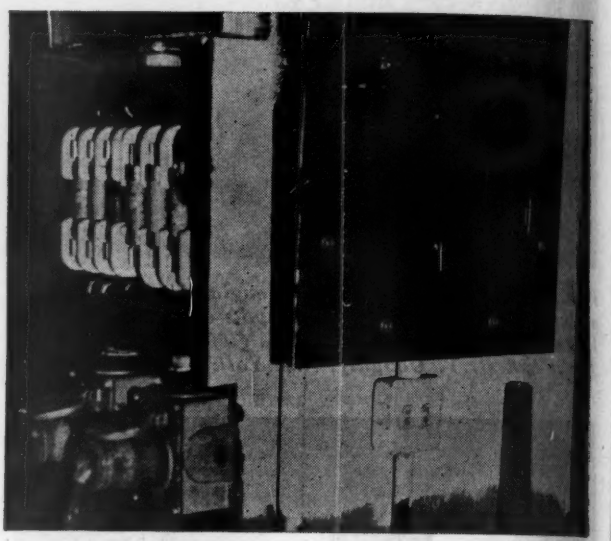
INSTRUMENT-MINDED journeymen came up after class to inspect various instruments that were reviewed and demonstrated by E. L. Ross, Meter Div., Westinghouse Electric & Mfg. Co., Newark, N. J.



THE WHY AND HOW—F. L. Shelley, San Jose, Calif.; H. A. Smith, Midvale, Utah; H. C. Potts, Nashville, Tenn.; and E. J. Bloomquist, Lawrence, Mass., by H. C. Dustman, electronic engineer, Allis-Chalmers Mfg. Co.

Load Center

TYPICAL LOAD CENTER substation with lighting transformer on left and power transformer on right. The 4160 volt four wire feeder drops to pull-box with single phase 2400 volt tapped-off for lighting transformer.



LIGHTING PANELS also serve the single phase 110 volt hand-tool receptacles which are mounted on each column. In the heavy welding area columns carry two welder outlets supplied by separate sets of fuses.

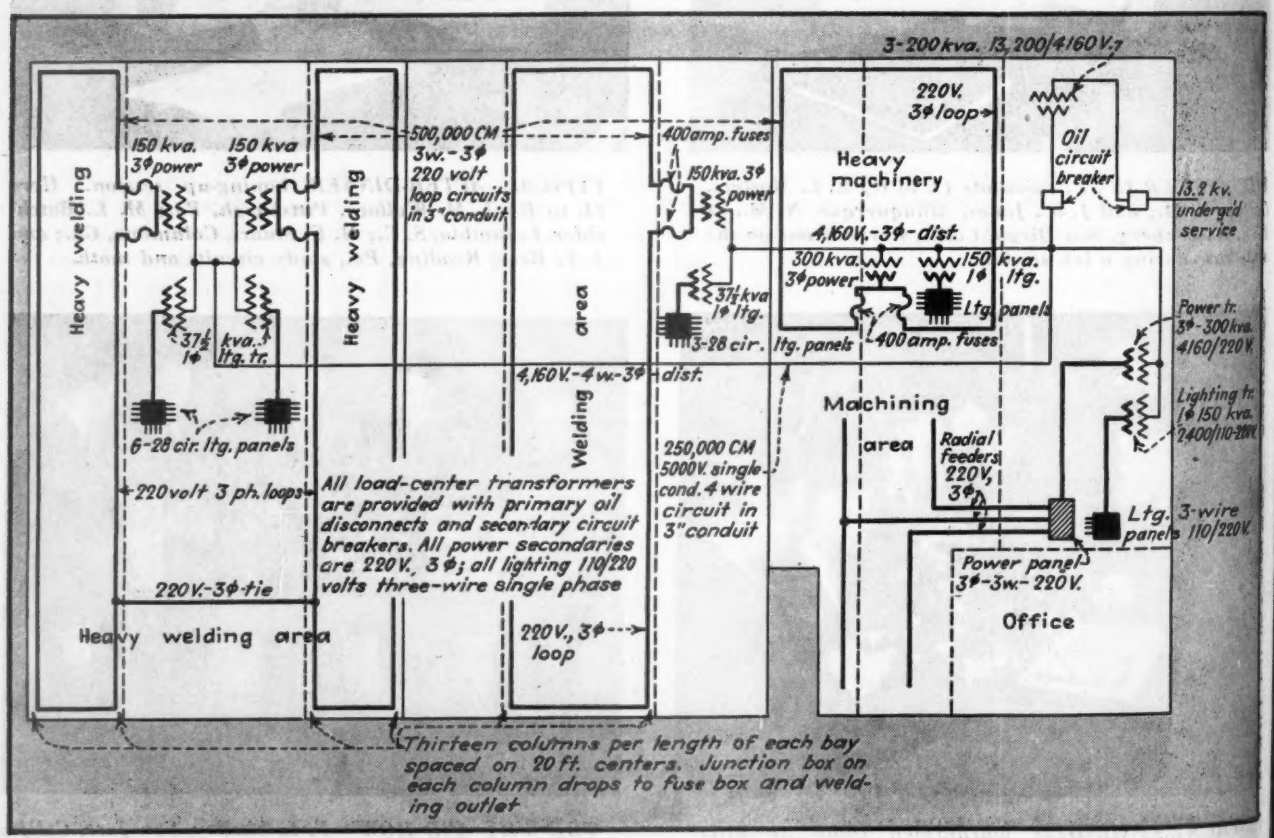
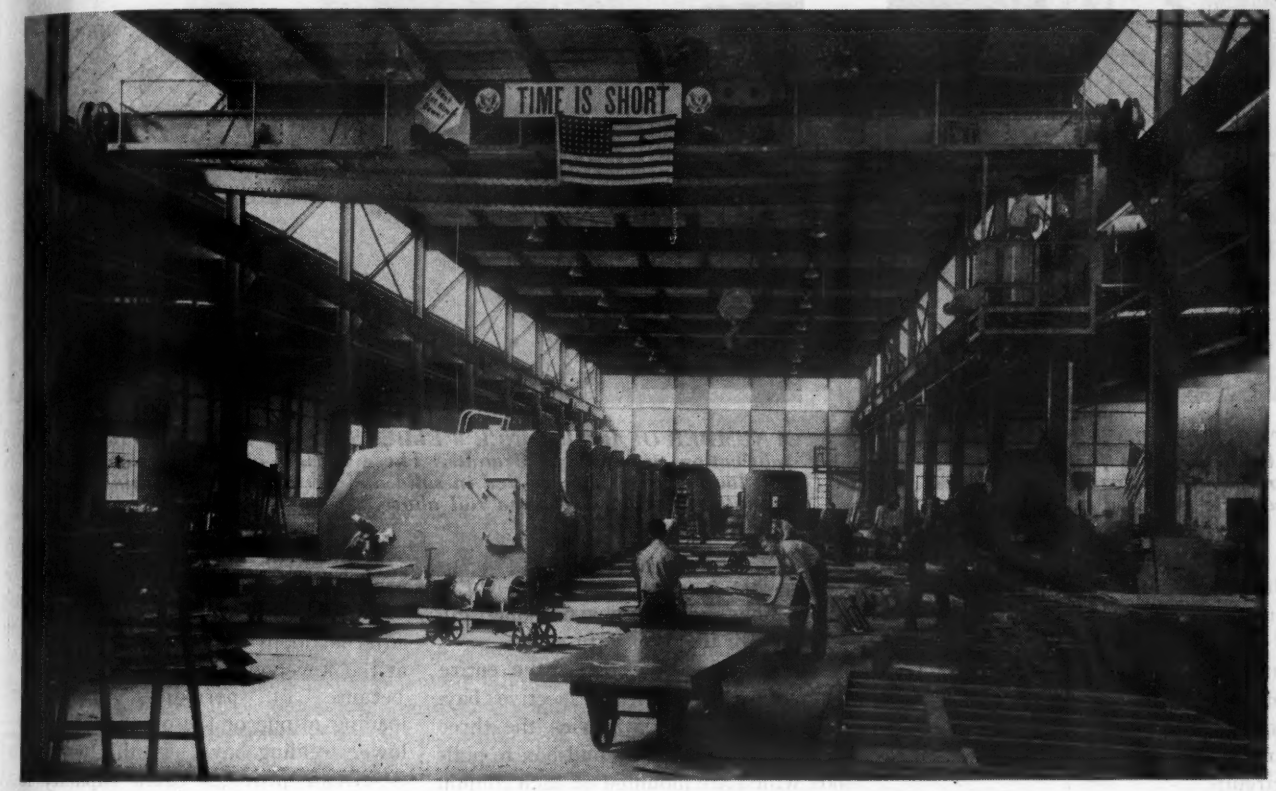

3-200 kva. 13,200/4160 V.
220V. 3φ loop
Oil circuit breaker
13.2 kv. underground service
Heavy machinery
150 kva. 3φ power
150 kva 3φ power
500,000 CM 3w.-3φ 220 volt loop circuits in 3" conduit
400 amp. fuses
150 kva. 3φ power
4,160 V.-3φ-dist.
300 kva. 3φ power
150 kva. 1φ ltg.
Ltg. panels
400 amp. fuses
37½ kva 1φ ltg.
3-28 cir. ltg. panels
37½ kva. 1φ ltg. tr.
Heavy welding
Heavy welding
area
Welding
4,160 V.-4w.-3φ dist.
Machining area
Radial feeders 220V, 3φ
Power tr. 3φ-300 kva. 4160/220 V.
Lighting tr. 1φ 150 kva. 2400/110-220 V.
6-28 cir. ltg. panels
220 volt 3 ph. loops
All load-center transformers are provided with primary oil disconnects and secondary circuit breakers. All power secondaries are 220 V., 3φ; all lighting 110/220 volts three-wire single phase
250,000 CM 5000 V. single cond. 4 wire circuit in 3" conduit
Ltg. panels
3-wire 110/220 V.
Power panel 3φ-3w.-220 V.
220 V.-3φ-tie
Heavy welding area
220 V., 3φ loop
Office
Thirteen columns per length of each bay spaced on 20 ft. centers. Junction box on each column drops to fuse box and welding outlet

FIG. 1—Wiring diagram is shown on building plan. High voltage distribution to load center substations is used with power and light circuits fed from separate transformer banks. Three phase 220 volt power loops are tied at lower left to increase capacity during heavy welding periods.

Distribution for Welders



ON EACH COLUMN beneath the crane rail can be seen the pull boxes and connecting conduits carrying the 220 volt three phase loop power circuits. Note also on each column (at floor level) the fuse boxes and welder outlets.

Radial primary feeders with paralleled loop secondaries provide adequate capacity and flexibility to handle expanding welder load.

By Robert E. Miller

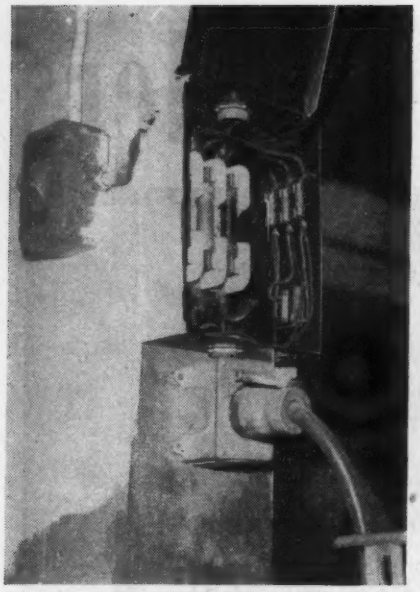
AN adequate wiring program begun in 1939 at Charles T. Brandt, Inc., of Baltimore, Maryland, was accelerated by war requirements and recently completed to provide greater flexibility and capacity. As fabricators of sheet metal assemblies, the major portion of Brandt's load is concentrated in the welding areas. In addition, two machining areas consume large amounts of power.

William G. Stockhausen, of Central Electric Company, electrical contractors in Baltimore, working in conjunction with Edwin Klaumberg, Brandt's plant electrical engineer, designed and installed a radial load center distribution system with adjacent loop secondaries tied for greater capacity. The secondary loop circuits, which travel the circumference of their respective bays, are entirely of a pull-box-and-conduit type with drops at each column to fused welder outlets. Thus, the nearly 100 portable welders can be located at any point in the shop without the nuisance of long and unwieldy cables.

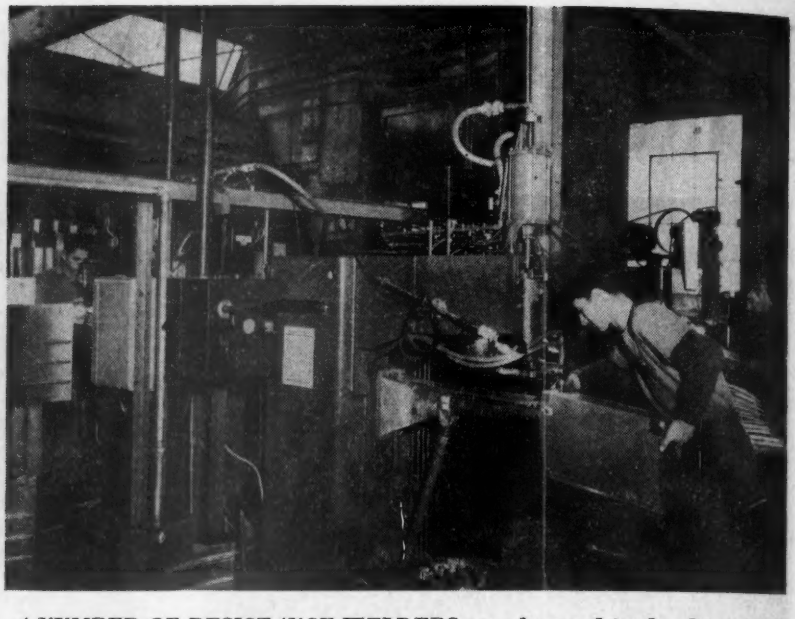
Service comes in from the street underground at 13,200 volts, through fused disconnects and an oil circuit breaker to the three 200 kva. main substation transformers. From the wye-connected secondary, a 4160 volt four wire circuit is carried through an oil circuit breaker in the main vault to a pull-box out in the shop where it is split into three separate feeders. Two feeders each supply two individual load center power and lighting banks, while the third feeds only one station. Primary feeders consist of four 250 MCM. 5000 volt single conductor cables in three inch conduit.

Load Centers

Light and power circuits are served from separate transformers at each load center substation. Construction is similar to that of the suspended station in the accompanying photograph. Transformer tanks are set on a wooden plank platform which lays across a channel-iron bridge suspended between columns. Units set at either end of the platform while the primary drops from above into a pull-box mounted on the crane rail I-beam. A phase-to-neutral 2400 volt single phase circuit passes through oil disconnects into the lighting tank on one side, while a three phase-four wire circuit enters



***THE FUSE BOXES** contain a set of 100 amp. fuses for welder receptacle and 30 amp. fuses for hand-tool receptacle mounted in side of box.*



***A NUMBER OF RESISTANCE WELDERS** are also used in the sheet-metal fabrication processes at Brandts. These welders also feed from the 220 volt loop circuits but are tied in solid and permanent at the junction box mounted beneath the crane rail above.*

the power tank through oil disconnects on the other side.

The three-wire 110/220 volt lighting secondaries drop from the tank breaker to the various lighting panels which serve hand-tool receptacle circuits in addition to the branch lighting circuits.

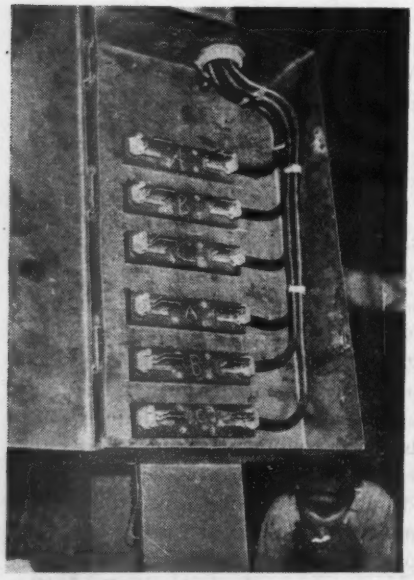
Loop Power Secondaries

The 220 volt three phase power circuit drops from its tank secondary breaker into a fuse cabinet like the one illustrated below which contains two sets of 400 ampere fuses. As shown in the accompanying plan wiring diagram, each end of the loop is fused.

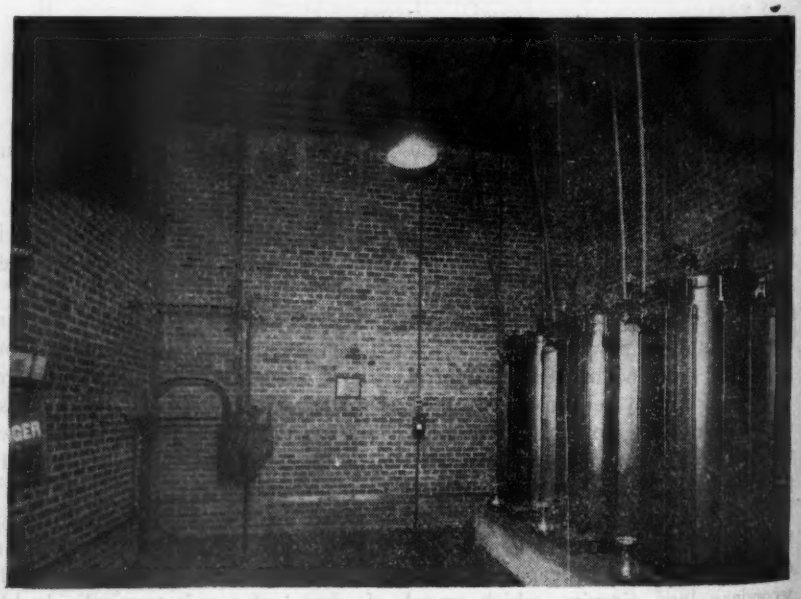
The loop circuit travels the entire circumference of its respective bay. Three inch conduit carries the three 500 MCM cables from pull-box to pull-box which are mounted on each column directly under the crane rails.

Conduit-drops are installed on each column to a fuse box containing one set of 100 ampere fuses for the welding receptacle (mounted directly beneath the box) and a set of 30 ampere fuses for the three-phase hand-tool receptacle installed in the side of the box.

In the heavy welding area, the two adjacent loops have been tied together at the lower end. This was necessary because of periodic extra-heavy loading in one or the other of the two lower welding bays. In this way, the tie-circuit provides extra capacity to whichever loop needs it, and at the expense of very little copper. The loop itself has resulted in a considerable saving of feeder copper over that which would have been required had the area been served by straight radial secondary feeds down each bay.



***SHEET - METAL JUNCTION BOX** houses two sets of 400 ampere fuses for the power circuit loop.*



***PRIMARY VAULT RECEIVES POWER** at 13.2 kv. Transformers are single phase tanks rated 200 kva., 13200/2400/4160Y. Oil circuit breaker is in 4160 volt feeder. Incoming 13.2 kv breaker seen on extreme left.*

LIGHTING TECHNIQUES—II

Part II of a series on lighting application. This article concludes the discussion of illumination fundamentals.

By Berlon C. Cooper

LIGHTING fixture manufacturers incorporate special features in their luminaire designs, such as patented type sockets, lampholders, globe holders, hinged frames, and features for ease of maintenance and relamping. Each manufacturer also uses his ingenuity in designing shapes, selecting finishes, combinations of glass, plastics and metal to achieve distinctiveness in his own designs. Because of these many variations in shapes, finishes, materials and combinations of materials, special features, etc., it appears that there are hundreds of classifications of luminaires. In the final analysis, however, luminaires as well as lighting systems may be divided into five broad classifications. For example, an indirect incandescent luminaire with an opaque bowl may be so classified regardless of the special features or finishes which any one manufacturer may incorporate in his own individual designs. Likewise, a cove equipped with reflectors, sockets and lamps and directing the light to the ceiling may be classified as an indirect lighting system, regardless of the type of reflectors, light sources, color of lamps, or other components which may be used.

Table I
COMPARISON OF LAMP EFFICIENCIES

TYPE LIGHT SOURCE	LUMENS PER WATT (Approximately)
Incandescent	
25 watt	10
60 watt	14
100 watt	16
150 watt	17
200 watt	18
300 watt	19
500 watt	20
750 watt	20
1000 watt	21
1500 watt	22
Fluorescent *	
15 watt	39**
20 watt	43
30 watt	48
40 watt	52
100 watt	42
Mercury Vapor	
250 watt	28**
400 watt	40
3000 watt	40

* Based on 3500° K. white lamps.
** Does not take into account watts loss in auxiliary equipment.

From the standpoint of the "lighting result" to be achieved, and the simplification of this discussion, no distinction is made here between luminaires designed for different light sources. A direct lighting type incandescent luminaire varies considerably in appearance, size and shape from a direct lighting type fluorescent luminaire. For purposes of classifying luminaires, or lighting systems, however, these differences are ignored.

Luminaires and lighting systems may be divided into five broad classifications as follows:

(1) Direct
(2) Semi-Direct
(3) Direct-Indirect
(4) Semi-Indirect
(5) Indirect

The definition for each of these classifications given below is based on normal practice.

Direct: A luminaire designed to distribute 90 percent or more of its light output downward below the horizontal is classed as direct. Such luminaire may be suspended, mounted on the ceiling or side wall, or recessed flush in the ceiling. It may have the light source exposed, or may conceal the source behind a diffusing medium of glass or plastic, or behind a louver. A typical example is an industrial steel reflector unit including socket and mounting hood or suspension.

Table II
COMPARISON OF OUTPUT FOR EQUAL LAMP COST

TYPE LIGHT SOURCE	LUMEN HOURS FOR 1¢ LAMP COST (LIST PRICE)
Incandescent*	
25 watt	35,000
60 watt	83,000
100 watt	107,000
150 watt	130,000
200 watt	135,000
300 watt	107,000
500 watt	82,000
750 watt	43,500
1000 watt	56,000
1500 watt	59,000
Fluorescent**	
15 watt	10,200
20 watt	12,300
30 watt	23,500
40 watt	55,000
100 watt	58,000
Mercury Vapor	
250 watt	16,000
400 watt	50,000
3000 watt	60,000

* List price based on inside frost type lamps.
** List price based on 3500° K. white lamps.

Semi-Direct: A semi-direct luminaire is defined as one which distributes from 60 to 90 percent of its light output downward below the horizontal, and from 10 to 40 percent of its light output upward above the horizontal. A semi-direct luminaire may be suspended, or mounted on the ceiling. It may also be wall mounted or pedestal mounted. It may have the light source exposed, or concealed behind a diffusing medium of glass or plastic, or behind a louver. A typical example is a four lamp 40 watt fluorescent luminaire in which the lamps are exposed on the bottom and sides of the metal body of the luminaire.

Table III

COMPARISON OF LIGHT SOURCES

	Incandescent	Fluorescent	Mercury Vapor
Color quality of light produced	Candle flame yellow to light yellowish white Small wattage lamps in colors	Daylight, soft white and 3500° K. white Also made in colors	Daylight with strong Bluish-green cast
Rated operating life	750 hours up to 150 watts 1000 hours over 150 watts Also special life lamps	2000 to 6000 hours Increased hours operation per start increases lamp life	2000 to 4000 hours Increased hours operation per start increases lamp life
Replacement cost (Lumen hours for one cent)*	35,000 to 107,000 lumen hours	10,200 to 58,000 lumen hours	16,000 to 60,000 lumen hours
Lamp efficiency	10 to 22 lumens per watt	**39 to 52 lumens per watt	**28 to 40 lumens per watt
Size and shape	2″ to 6½″ diameter in tear drop and pear shape Also short tubular	1″ to 2½″ diameter tubes. 1½ to 10 feet long	Tubular-short and long

* Published list price used.
** Does not include wattage of auxiliaries.

Direct-Indirect: A direct-indirect luminaire is defined as one which distributes from 40 to 60 percent of its light output upward above the horizontal. A direct-indirect luminaire may be suspended, mounted on the wall or ceiling, or pedestal mounted. The light source is concealed in a diffusing medium in this luminaire. A typical example is a round ball diffusing glass globe suspended on a stem or chain suspension fixture.

Semi-Indirect: A semi-indirect luminaire is defined as one which distributes from 60 to 90 percent of its light output above the horizontal, and from 10 to 40 percent of its light output below the horizontal. It may be suspended, mounted on the wall, or pedestal mounted. The light source is concealed from view below the horizontal by a diffusing medium, usually glass or plastic. A typical example is a four lamp 40 watt fluorescent luminaire having the lamp mounted above a dense diffusing medium and suspended from the ceiling with a stem or chain suspension.

Indirect: A luminaire designed to distribute from 90 to 100 percent of its light output upward above the horizontal is classed as indirect. It may be suspended, mounted on the wall, or pedestal mounted. The light source is concealed from view below the horizontal. A typical example of an indirect luminaire is an opaque metal bowl suspended from the ceiling.

Any lighting system as well as any luminaire may be classified under one of the above classifications, whether the lighting result is achieved through the use of some type of built-in lighting equipment, cove lighting, coffers, individual luminaires, or other systems where architectural elements and lighting equipment are combined.

With a full appreciation of the various qualities and advantages of each type of light source, of the exact lighting effect desired, and of the lighting result which can be obtained from each of the five classifications of luminaires, we have an opportunity to provide proper illumination for any type of building and at the same time to enhance and improve the architectural effect. Lighting, when understandingly applied, properly becomes a part of the architecture. It is therefore important that the architect, the designer, the consulting engineer, the electrical contractor, and the owner have a better understanding of lighting in all its variations and in the multiplicity of factors entering into the achievement of any lighting result.

Lighting Economics

Cost is almost always an important factor in lighting. The total cost of a building project is usually limited. Lighting must compete with other useful or decorative features for its share. It is usually necessary, therefore, to study the cost of a proposed lighting result and to compare it with other possible lighting results. A lighting result should be selected primarily on the basis of its suitability for the seeing tasks involved, and on the decorative and architectural effects to be obtained. But since it is possible to obtain a specific lighting result through the use of several different lighting techniques, or through the use of either of three different light sources, and of several types of equipment, it is important to understand what factors enter into a cost analysis of a lighting system, in order to make an intelligent study and comparison. Such comparisons should be based on equal illumination results and comparable quality of lighting.

The client is interested not only in the initial investment in lighting equipment as related to the total project cost, but also in the annual maintenance and operating costs.

First Cost of Equipment: This factor includes those items which are necessary to produce the desired lighting result, other than replacement items. Some of the more important of these items are:

1. Wiring cost.
2. Lighting equipment cost.
3. Lighting equipment installation cost.
4. Prorated cost of air conditioning equipment necessary to dissipate the heat from the lighting load.
5. Cost of any structural or architectural construction necessary to provide details required by the lighting system.

The wiring cost involved in calculating costs naturally should be limited to that wiring necessary for furnishing current for the lighting load. For bidding and other purposes, wiring costs are usually included in the electrical work, while lighting fixtures and equipment are considered a separate item. But in order to properly compare the cost of one lighting system with another, the cost of the electrical wiring system necessary for the lighting load logically must be taken into consideration in order to reflect any differences in such costs.

Item 2 above covers the cost of the

lighting equipment such as reflectors, wiring channel, louvers, lenses, and other equipment necessary to achieve the desired lighting result for the system of lighting selected. Such luminaires and lighting equipment are normally classed as capital equipment, and should be included under "first cost."

The cost of installing the luminaires and other lighting equipment must also be included in any comparison of lighting costs. This item is also normally lumped with other labor under electrical work when contracts are awarded. But in order to compare the cost of one lighting system with another, it must be considered as a part of the cost of the lighting system.

Much may be said both pro and con about including a prorated part of the cost of the air conditioning system as a part of the cost of the lighting system. It may be argued that whereas the heat from the lighting load must be dissipated in hot weather, it contributes to heating in cold weather. In large buildings where the lighting load is a sizable factor, and relatively high intensity foot-candle levels are planned, if it is necessary to use the next size larger air conditioning unit, including larger sizes for wire, conduit, panels, transformers, etc., in order to provide proper air conditioning, then this item must be included as a part of the lighting cost. If the heat is generated within the building, it must be dissipated, or the air conditioning system is not fully effective. Any additional costs in the air conditioning equipment attributable to the lighting load should therefore be included as part of the cost of lighting.

When lighting becomes a part of the architectural treatment, it is often necessary to provide special structural or architectural treatment to house or support or otherwise accommodate the lighting equipment. The cost of any such modifications in structural or architectural details should be added to the cost of the lighting system. A simple example of such treatment is a cove in an executive's office. If the desired lighting result is 25 foot-candles of indirect illumination, it could be obtained with a cove lighting installation or with suspended indirect luminaires. In comparing the cost of these two systems, the cost of the cove, including structural members and plaster or metal to form the cove should be included in the cost of the lighting system, since the cove would not be required for the suspended luminaire system to achieve the same result.

It is again pointed out, for emphasis, that only the lighting equipment cost and installation cost are normally classified as the first cost of a lighting system. However, when the cost of one lighting system is compared with another lighting system, the other items discussed above, or differences in costs of any other items due to different lighting treatment, must also be considered.

Maintenance and Operating Cost: This factor includes the cost of replaceable items having limited operating life, maintenance, and cost of items which vary due to change in rate of use. The important items included in this factor are:

1. Cost of lamps
2. Cost of electrical energy
3. Cost of labor for maintenance
4. Cost of materials required for maintenance

In figuring lamp costs, the net cost should be used. Annual hours of operation must be estimated, and the cost prorated as compared with average rated lamp life.

In estimating energy costs, it is necessary to carefully estimate the number of hours of operation annually, and to determine the kilowatt hour cost rate based on the probable total kilowatt hour demand. If the proposed lighting system uses either fluorescent or mercury vapor lighting equipment, the energy consumed by the auxiliaries (ballasts or transformers) must also be included.

Labor for maintenance includes labor for replacing lamps, and for cleaning and repairing the luminaires or lighting equipment. For buildings located in industrial areas, near railroads, or in heavy traffic areas, the lighting equipment must be cleaned more often than when the buildings are located in less dusty locations.

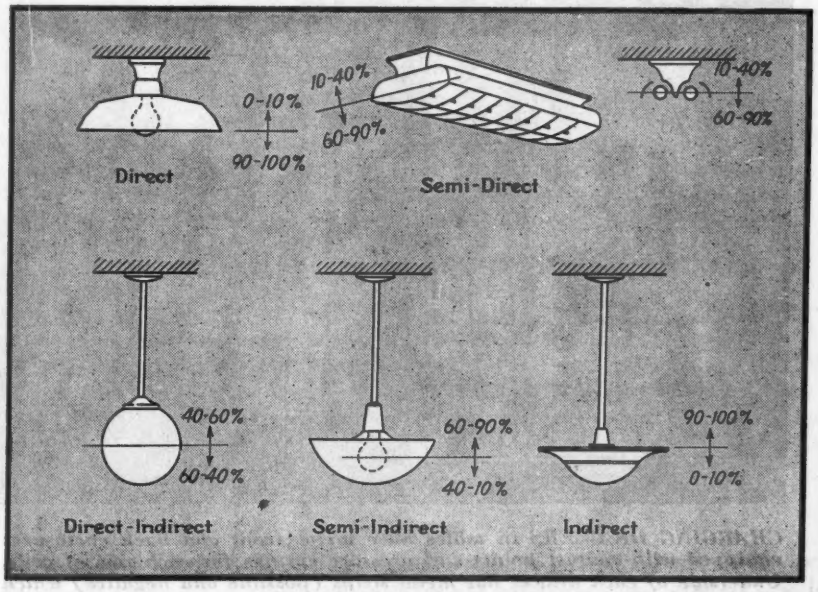
Included in the cost of materials required for maintenance are such items as cleaning compounds, parts for repair, such as glass, sockets, etc., lamp changers, ladders, and similar items.

Once the first cost of equipment has been established, a "fixed annual charge" on the investment in this equipment can be set up which will include interest, taxes, insurance and amortization. This "fixed annual charge" should also be included in the cost comparisons.

The electrical contractor well knows the practice of many architects and builders of postponing the planning of the lighting until a building is approaching completion. The "lighting fixtures" are selected and purchased at the last minute, and usually price is a governing factor in the selection. The result is well known. Very seldom is the proper "lighting result" achieved. It is more often inadequate, expensive to operate, and does not harmonize with or enhance the architecture. Selection of the units is limited in such instances also, since the lighting outlets have usually been installed on a rule of thumb wiring basis without proper regard for lighting results.

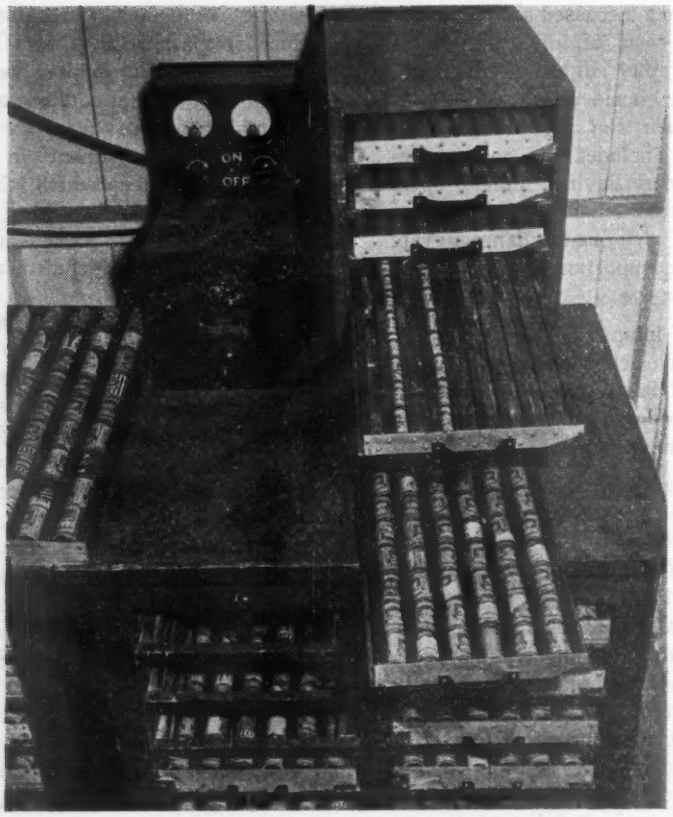
How much more satisfactory it would be for the electrical contractor to consult with the architect and consulting engineer on a project and advise intelligently on modern lighting and wiring practice!

Future articles involve case studies of plans for actual projects.

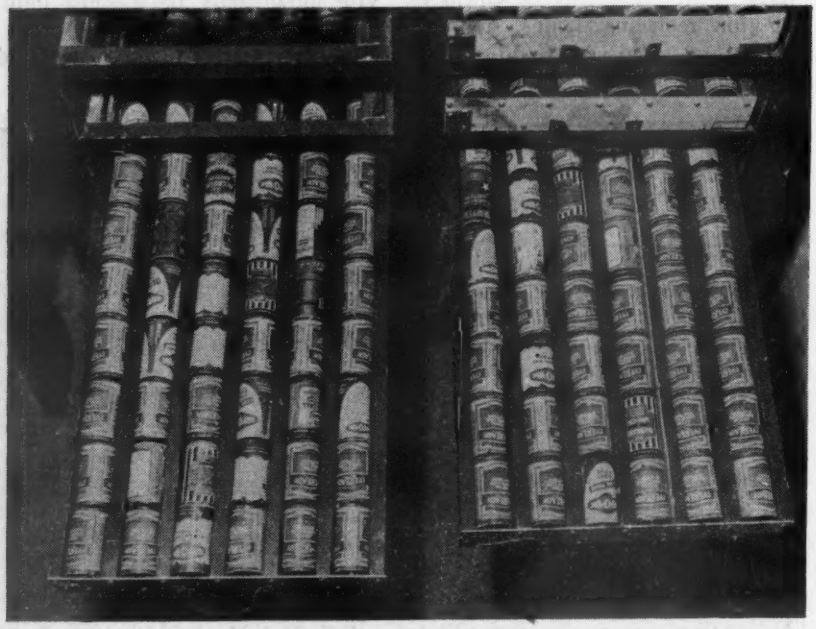


LUMINAIRES classified by light distribution.

DOUBLING



***SUPPLEMENTARY CABINET** accommodating pen size and medium size flashlight batteries operates on the same principle as larger tables. Interchangeable drawers hold nine rows of pen size and six rows of medium size batteries.*



***CHARGING DRAWERS** in tables have metal front and back enclosures equipped with contact points and pressure springs for each row of cells. Underside of each drawer has metal strips (possible and negative) which ride on similar metal slides over drawer supports. Electrical contact is made the instant drawers are placed in table.*

WHEN war demands had created an acute shortage of dry cell batteries, resourceful employees of North American's Texas Division came to the fore with an expedient means of relieving the situation—the development of two ingenious dry cell rejuvenators that have stood the test of two years operation.

To the aircraft industry, flashlights are a "must" item of equipment playing an important part in inspection for maximum structural safety. At North American's Texas Division, company inspectors use flashlights to make 60,000 different and individual inspections of each P-51 Mustang fighter and 35,000 inspections of each AT-6 Texan trainer before the planes are turned over to the Army Air Forces. Considering the production schedule that had to be maintained and the safety feature involved, it was imperative that there should be no moratorium on the company's flashlight battery supply.

The units consist of wooden tables 36-inches high, 32-inches long and 30-inches deep. Each table is equipped with a charging unit and two tiers of six shallow drawers (total of 12 drawers per table). Each drawer is divided into six channels by ribs of $\frac{1}{2}$-inch material, each channel accommodating a row of nine batteries. The front and back of each drawer consists of a metal plate with a $\frac{1}{16}$-inch metal point forming the contact at the front of each row of batteries and $\frac{1}{2}$ inch, medium tension springs on the back plate exerting constant pressure on the batteries. The under side of each drawer is equipped with metal rails (positive and negative) which rest on similar positive and negative metal slides mounted to the drawer supports. Electrical contact thus is made the instant the drawers are placed in the table.

A Tungar Charger (Model 6RB19-Y2, 5-amp., 115-volt, 60-cycle) with an adjustable reheostat and a voltmeter and ammeter panel, constitutes the charging unit. Normally the charger is set for a potential of 18 to 20 volts and a charging current of 1/10-ampere for each row of batteries. A toggle switch on the meter panel disconnects the battery circuit from the charger to prevent discharging the batteries when the unit is off.

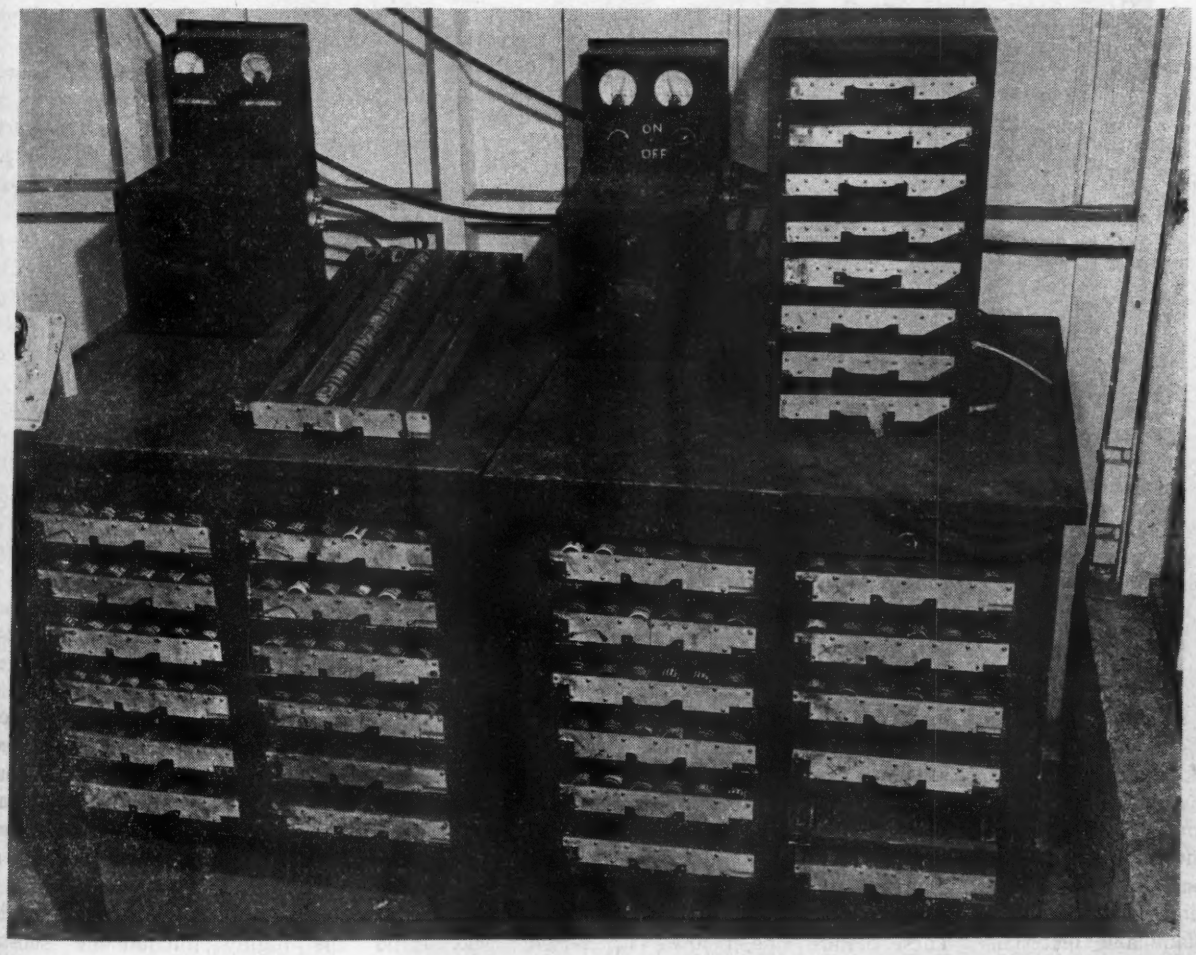
DRY CELL LIFE

A unique recharging table more than doubles the life of thousands of dry cell flashlight batteries used in the production, inspection and plant protection departments of North American Aviation's Texas plants.

Batteries to be recharged are placed in the drawers, nine to a row. Operators are careful to have the positive end of each battery toward the front of the drawers to prevent shorting out an entire row of batteries. They also carefully inspect each battery to be recharged and cull out the corroded ones before loading the table. Batteries are allowed to remain on charge for 48 hours, then are removed and stored for approximately 12 hours before testing. This practice permits the operator to detect unusual drops of current within the batteries and to discard those failing to take a proper charge. Batteries can be recharged a drawer at a time if necessary.

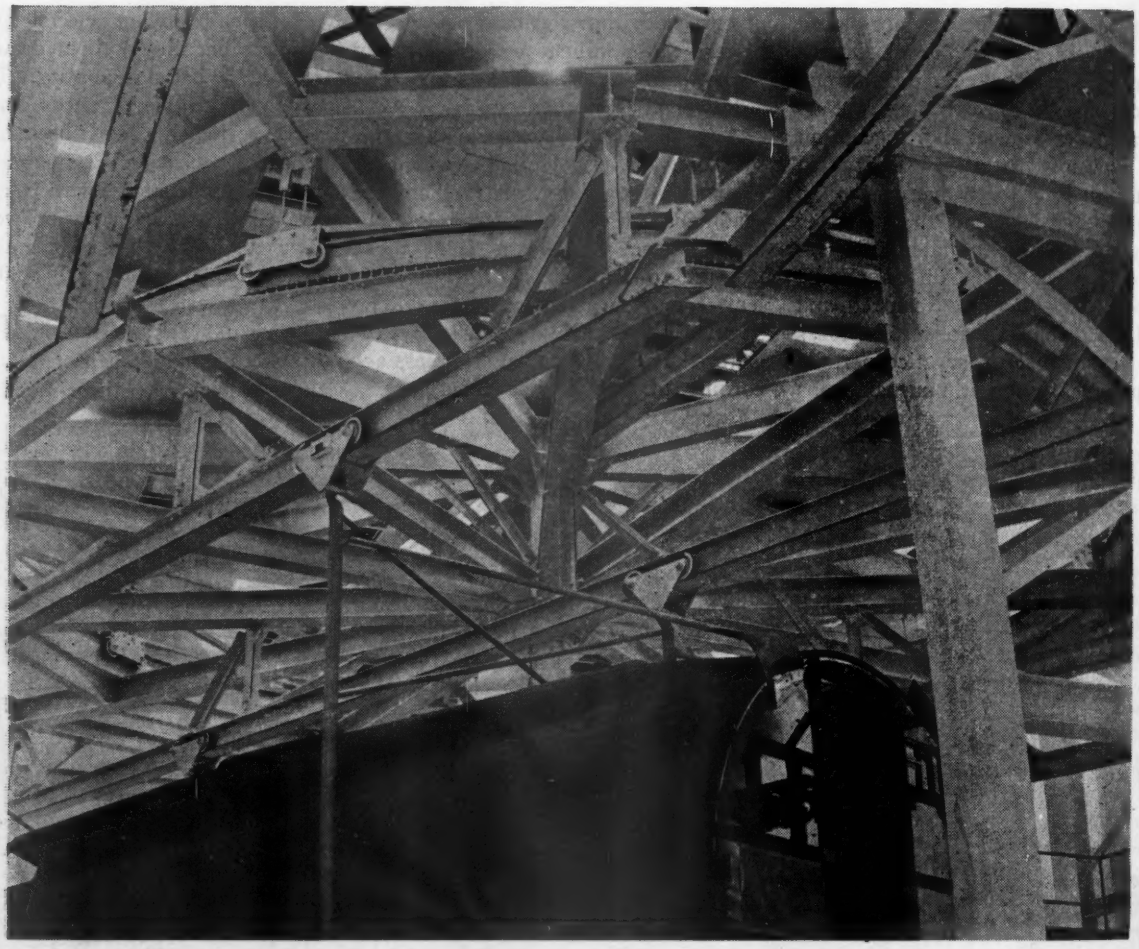
Any flashlight battery with more than one volt is potentially capable of recharge regardless of the ampere reading. All batteries that test 10 amperes are as good as new; those testing 5 to 10 amperes will give excellent service but have shorter life. The same batteries may be efficiently recharged from five to eight times, according to maintenance experience.

Originally, plant electricians built a single flat unit without drawers and with a 450 battery capacity. This unit supplied the plants' needs for a two-week period. When it became evident that the recharger was practical, the larger rejuvenators with a combined capacity of 1296 batteries were constructed. Today they recharge approximately 14,000 of the nearly 35,000 flashlight batteries issued to North American's Texas Division inspection, production and plant protection departments during each three-month period.



***RECHARGING TABLES** give new life to thousands of flashlight batteries at North American Aviation's Texas plants. A Tungar rectifier for each table provides the charging current. Cabinet at right of charger is for pen size and medium size batteries. Table drawers take large size only.*

Lighting Aircraft SPRAY BOOTHS



LARGER SECTION OF THE SPRAY BOOTH with overhead lighting through glass lenses, and showing how work is brought in by straight, overhead carrier and is later transferred to the circular one above, so that the spraygun operators can always "shoot down wind."

LIGHTING of paint spray booths in the aircraft industry, as exemplified by the operations of the Douglas Aircraft Co., Inc., of Santa Monica, Calif., is well standardized and conforms to the standards of the National Board of Fire Underwriters for paint spraying and spray booths using inflammable materials. These standards allow certain modifications, only to the National Electrical Code's article 500 covering electrical apparatus in hazardous locations. The Underwriters, in their pamphlet No. 33 define hazardous locations as areas not exceeding 20 feet from the spray booth, but add that in the case of lamps, the latter may be used within the 20-foot limit provided they are of the type approved for explosive atmospheres, or may be of the enclosed "vapor-tight" type. In no case, however, shall portable lamps be used nor shall lamps be located inside the spray booths and ducts or where there is possibility of the spray coming in direct contact with lamp or fixture.

The reason for this is obvious, in as much as a coating of the spray deposited upon lamp and fixture conceivably might result in an increase in the temperature of the surface to a point which might result in the ignition of the highly inflammable substances. That certain recent experiments indicate that the temperature rise in a lamp, caused by coatings of this character,

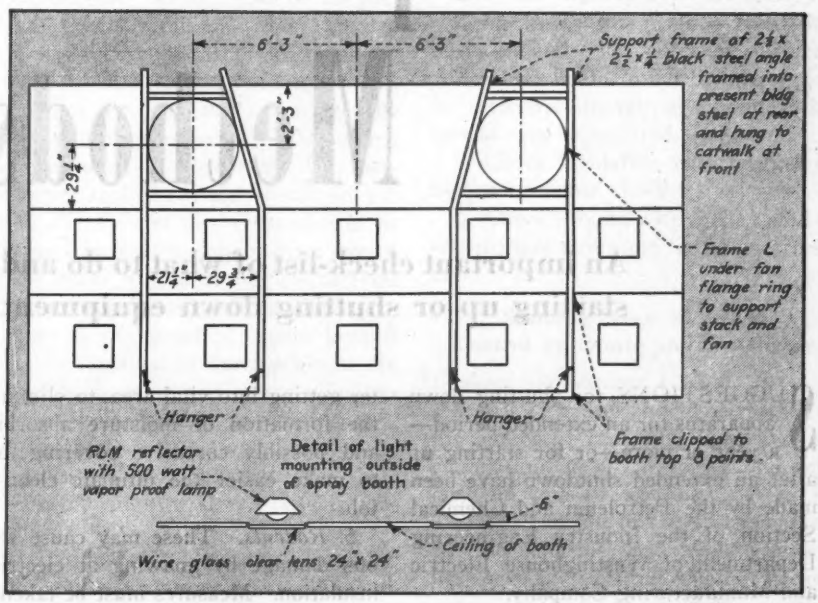
How paint spray lighting in the aircraft industry is designed and installed for safety and effective seeing.

is not nearly so great as might be expected, does not alter the case, so that Douglas, at least, is taking no chances, and all lighting of spray booths is through lenses or windows of wire glass, from lights outside the booth.

One unit or section of a typical Douglas paint spray booth, for B-17s, in the Long Beach plant is shown in the drawing. Many such booths have been designed and built by the DeVilbiss Company of Toledo, Ohio, through its Los Angeles office. The plan shows the location of the lens openings, which in this type of booth are all located in the ceiling. The fan equipment is also located on top of the booth.

The typical complete booth is 25-ft by 75-ft. by 35-ft. high, inside dimensions. Air is drawn into the booth, usually through a filter, and it passes out through a water curtain so that none of the inflammable material can escape to the outer air. The work is brought into the booth by an overhead carrier system, and in some cases transferred to a second, circular track within the booth, so that the work can be sprayed all around with the operator directing the spray with the air flow rather than against it.

Lighting of the whole interior is by means of 500-watt vapor-proof clear lamps in RLM reflectors, so mounted that the edge of the reflector is six inches above the lens. The total number of lamps is 60 per booth, giving 20 foot-candles of illumination at the work level.


6'-3"
6'-3"
Support frame of 2½ x 2½ x ¼ black steel angle framed into present bldg steel at rear and hung to catwalk at front
2'-3"
2'-9¼"
Frame L under fan flange ring to support stack and fan
21¼"
29¾"
Hanger
Hanger
Frame clipped to booth top 8 points
RLM reflector with 500 watt vapor proof lamp
Detail of light mounting outside of spray booth
6"
Ceiling of booth
Wire glass clear lens 24" x 24"

***GENERAL LAYOUT PLAN** of one section of spray booth, with detail of lamp and fixture locations.*

***SHOWING THE CEILING LENSES** of wire glass through which the light from 500-watt lamps shines to give 20 foot-candles at work level.*

Start-Up and Shut-Down Methods

An important check-list of what to do and how to do it when starting up or shutting down equipment for long periods.

SUGGESTIONS for shutting down apparatus for an extended period—a year or more—or for starting up after an extended shutdown have been made by the Petroleum and Chemical Section of the Industry Engineering Department of Westinghouse Electric and Manufacturing Company.

A certain amount of deterioration or damage will occur which cannot be eliminated by any ordinary means. However, it can be kept to an absolute minimum. It is assumed, therefore, that measures to be taken are to be practical, and reasonable in cost, consistent with the cost of the apparatus, the desired future value, and the cost of corrective measures that would be necessary when the plant is started up again. Such practical preventive measures, and subsequent corrective measures should result in a condition of equipment favorable to continued operation.

The chief agencies of deterioration to be considered are:

1. *Moisture absorption into electrical insulation.* If minimized, the absorbed moisture can ultimately be driven out by proper heating and drying methods with little permanent injury.

2. *Corrosion—rusting of ferrous parts.* Corrosion of vital areas, such as bearings pivots, gears, sealing surfaces, and magnetic iron, must be minimized. Very little corrosion at these surfaces would in many cases render the equipment inoperable. Only close inspection of such vital areas at start-up can determine what degree of corrective measures will be necessary.

3. *Corrosion of non-ferrous parts*—particularly current carrying contacts. Such contacts are usually accessible and can be preserved by protective coatings easily removable at start-up.

4. *Dust and dirt.* This must be minimized to reduce chance of foreign matter getting into vital area, to eliminate the formation of moisture absorbing and possibly corrosive covering, and to make easier the ultimate clean-up job.

5. *Rodents.* These may cause serious damage by gnawing at electrical insulation. Measures must be taken to keep the number of rodents and their chance of access to vital parts to a minimum.

Plant heating and ventilating systems may be used to maintain some minimum amount of heat as required to prevent sudden temperature changes and consequent excessive sweating. Or, individual pieces of equipment may be supplied with a constant amount of local heat, to keep their temperature always above ambient, thereby preventing sweating. To make the heater more effective the piece of apparatus should be enclosed in a wooden housing covered with a waterproof paper to minimize air currents, restrict the loss of heat and the entrance of moisture. A small vent in the top may be desirable for minimum ventilation. Or, it may be enclosed in a wooden housing covered with waterproof paper sealed to effectively restrict air circulation. A container of some deliquescent material, such as calcium chloride, would then be placed within each enclosure. The amount of this drying agent for keeping the air dry, and absorbing any sweating that may occur in extreme cases, should be adequate for a considerable period. This scheme would require no heat or connected power in the building, except possibly a very limited amount of emergency lighting. Or, the building may simply be maintained in good weather proof condition, without heat, with the apparatus slushed with protective coatings on vital mechanical and electrical areas, and covered with a heavy paper. Such protection would make no attempt to minimize sweating, and would no doubt result in considerable permanent damage to electrical insulation. Such minimum measures are not considered adequate and are therefore not recommended.

Shutting Down Rotating Electrical Power Apparatus

Identification Record—list all apparatus giving complete nameplate data, location of machine, and application.

Frame—(a) clean by blowing and wiping all dust, dirt and grease from all accessible surfaces; (b) eliminate any accumulations of water; (c) paint any portion from which protecting coating has been removed.

Bearings—(a) oil reservoirs of sleeve bearings or anti-friction bearings should be left filled with oil to normal level. In many cases it will be desirable to add to the oil a rust inhibitor (8 to 10 percent by volume should be added to the reservoir and the machine run for ½ hour before final shutdown); (b) grease-lubricated antifriction bearings should be completely filled with grease.

Nameplates—apply a coating of light grease, or clean and cover with a coat of clear varnish.

Shaft—cover exposed sections with suitable slushing grease.

Key Way—give small application of penetrating oil.

Conduit Box—add a drop of oil or a small amount of grease at each conduit box cover screw.

Windings—clean thoroughly by wiping and blowing all dirt and dust from the windings and coils of both the stator and rotor. For blowing use dry compressed air at a pressure of not more than 50 pounds per square inch. Oil or grease on windings should be thoroughly removed by use of stoddard

solution, carbon tetrachloride, or a mixture of the two. Subsequent to such cleaning apply coating of air-drying insulating varnish.

Covering—each machine, or machine with its driven or driving member should be effectively covered with heavy wrapping of paper, canvas, or a wooden enclosure with waterproof paper covering. Such coverings are to be effective in keeping out dust, and in minimizing air circulation in case space heaters or moisture absorbing material is used under the enclosure.

Chain and Belt Drives—belt or chain drives are to be slacked off or preferably removed. The chains should preferably be stored in a tank of light lubricating oil. The belt should be stored in a cool dry place.

Specific Suggestions

1. A-C squirrel cage motors—no additional special measures need be taken.

2. A-C wound rotor motors, synchronous motors and alternators—remove all brushes from brushholders and leave suspended on shunts. If rings are steel, cover with a suitable rust resistant compound. If rings are of non-rusting material such as brass, cover with tight fitting heavy paper, so secured as to permit possible occasional manual rotation of the shaft.

3. D-C generators and motors—clean commutator, and all creepage surfaces of dirt and grease. Remove all brushes from brushholders and leave suspended on shunts. Cover commutator with a tight fitting, heavy paper.

4. Large slow speed A-C and D-C motors and generators—take precautions listed for smaller machines. The rotors of such large machines should be left in their normal position. The rotors need not be blocked up to relieve bearing pressures. Avoid water accumulation in pits.

5. Fractional hp. A-C and D-C motors—no special measures required as these motors are usually well enclosed. To prevent screws in contact with aluminum alloys from seizing, a fresh coat of anti-seize compound may be applied to such screws.

Starting-up Rotating Electrical Equipment

1. After building interior has been cleaned, carefully remove covering of machines.

2. Clean machine externally and internally by wiping and blowing. Remove any protecting coatings.

3. Inspect windings for damage by rodents, grease or oil soaking, or excessive deterioration. Repair as required. Clean under-cut commutators thoroughly.

4. Check insulation with megger or by power-factor check.

5. Windings may be dried out by applying low voltage (10 to 25 percent) to field coils, and low value of a-c or d-c current (10 to 25 percent of rated) to main circuit windings for a period of 8 to 48 hours as dictated by insulation measurement. Winding temperature, as observable by thermometer applied to coils, should not exceed 75° C. and this value should be reached in not less than three hours. (For exact procedure get instructions from manufacturer). If the above procedure is not practical, spare heaters may be installed in the machines. In some cases rotor and stator windings may require baking and dipping in a repair shop.

6. Inspect bearing surfaces and check oil rings of sleeve bearing machines.

7. Drain out oil, flush housing, and add required amount of specified oil. In case of grease lubricated anti-friction bearings, fill housing with new grease forcing out all old grease. Do not remove bearing unless damage is apparent.

8. Rotate shaft manually or by some mechanical means, if possible.

9. If possible, rotate machine slowly, at no load, listening for unusual bearing or other noises.

10. Put full voltage on machine.

Shutting Down Non-Rotating Electrical Power Apparatus

This type of apparatus, which would include transformers, static condensers, reactors, and lightning arresters, having no bearings or rotating parts, needs very few special protective measures. A few may be mentioned.

1. Cases or tanks should be in good condition, and damaged protective coatings touched up.

2. Oil immersed equipment should not be disturbed unless a check of the oil indicates the presence of an excessive amount of moisture, in which case moisture-free oil should be supplied.

3. Exposed windings, such as on current transformers, dry type auxiliary power transformers, and reactors, should be cleaned of any possible oil or grease, and any damage to the surface coating repaired with an application of an air-drying insulating varnish.

Static condensers need no protective measures other than touching up any damaged spots on the case painting. Do not attempt to change the oil.

Lightning arresters need no special attention. They should not be disconnected from apparatus or ground.

Starting-Up Non-Rotating Electrical Power Equipment

1. Clean thoroughly, externally.

2. Clean thoroughly all insulating bushings and other porcelain surfaces.

3. Check transformer insulating oil for dielectric strength and sludge. Renew as may be required.

4. Check insulation with megger or by power-factor check.

5. Check ground wire and ground of transformer tanks and lightning arresters.

Shutting-Down Electrical Control Apparatus and Switchgear

General Suggestions

1. All apparatus should be cleaned to the extent of removing abnormal accumulation of oil or grease, particularly on coils or windings.

2. Mechanical linkages, mechanical trip mechanisms, etc., should have a light protective coating of oil or grease.

3. Copper busbars, knife switches and electrical contacts should not be greased, unless corrosive conditions will be very bad. Should a protective coating be required, use a light application of vaseline.

4. Complete switchboards and control panels should be protected against dust accumulation by at least a paper covering. They should also be protected against sweating by one of the means previously suggested.

5. Damaged surface coatings should be touched up.

6. Oil immersed apparatus should have oil changed to provide pure and clean oil for storage.

7. Spare heaters should be maintained in outdoor cabinets housing indoor apparatus, if at all practical.

Specific Suggestions

1. Oil Circuit Breakers.
   - (a) Renew the oil in oil-immersed circuit breakers to provide pure oil for storage.
   - (b) Leave breaker in place, completely assembled. Clean all parts of dirt and excessive grease by dry air blast at not more than 50 psi. and by wiping.
   - (c) Repair surface damage to solenoid coil by application of air drying insulation varnish.
   - (d) Lubricate sparingly any metallic pivot points or sliding surfaces.

2. Contactors—main and auxiliary.
   - (a) Grease pole face of a-c contactors lightly with vaseline.
   - (b) Do not oil pivots.

[Continued on page 184]

***JOBS ARE HANDLED** from small trucks and trailers. The trailers provide complete living accommodations for the three man crew. The truck carries tools and equipment. Crew handles two jobs a day in the field.*

Wiring GRAIN ELEVATORS

Lighting plants and wiring for 800 isolated grain elevators are handled from trailer shops.

By F. H. Fullerton

AN unusual contract involving many unusual problems of management and methods was handled last year by the Sun Electrical Company of Regina, Saskatchewan, Canada.

In the spring this company accepted a contract to install a Continental electric light plant, generator, battery and conduit wiring for 32 volts in 800 grain elevators in the province of Saskatchewan, and also a similar installation in a limited number of elevators in Alberta and Manitoba. Naturally the need for these installations only arose in elevators in the more remote and isolated villages and towns, and this fact added to the problem of making installations with the maximum of economy and efficiency. The problem was solved by the use of mobile crews with trailers to provide for their complete living needs. The contract was placed with the Sun Electrical Company by the Saskatchewan Wheat Pool and 12 other grain companies, all of whom joined in the projects. This cooperation of all elevator companies meant that in some sections three elevators had to be wired, and in other places only one or two.

The Continental Auto Supply Co. at Brandon, Man. developed the idea of the installation. For years the firm has been working on the supply of generators belted to the elevator engine, and fitted with batteries and panels. While many individual installations were made it was only last spring that the wholesale adoption of this electrification of isolated elevators was decided on, and the contract placed.

J. R. Young, himself a professional engineer, and head of Sun Electrical worked out the trailer system for handling the work. He now has four of these car-trailer units in operation. Each unit has a crew of three men. The unit was equipped with tool house with all necessary tools, work bench, ladders, etc., all of which were mounted in or on the truck unit. The trailer was entirely devoted to living accommodations and had bunks for three, toilet and washing facilities, and complete necessary furnishings.

The men in the crews were given special training before being sent out on the field, and were thus equipped with full details of the installation work. Where possible pre-assembling was done in the main Sun shops in Regina and parts shipped to the jobs partially assembled. All installations were made on a unit contract price.

Where the elevators were closely spaced an average of two installations per day were completed by each crew. One of the problems was to secure speedy installation, and this was encouraged by a bonus system, but stress was laid on the fact that the installation must be complete with no call backs.

To secure the desired finality Mr. Young adopted a system of giving his men special training, and endeavoring to anticipate the majority of obstacles and problems they would encounter in the field. Then he fitted each truck workshop with every type of tool that was likely to be needed in an emergency, as well as those required in regular work. Care was also taken to work out right lengths in ladders, and every stage of the work was carefully planned.

For the first few weeks the field parties were in continual touch with the head office by telephone, but the long distance calls fell off as the men became more familiar with their work.

All wiring installations were of standard specifications, so that the plants can be changed over to hydro electric as soon as rural electrical extensions are completed.

A map hangs in Mr. Young's office in Regina and as each job is reported completed a colored pin is inserted. Three different colors are used. One denotes jobs done, one denotes the points where men are actually working, with a third color for the jobs still to be done.

The company has developed many new and unusual types of maintenance, repair, installation and contracting work, of which the 800 elevators are a typical example.

Remote Control Scheme

Control problem was first submitted to Reader's Quiz for ideas. The questioner now describes his own final solution.

By L. R. Bagwell, *Mutual Electric Company, Houston, Texas*

AS STATED in my question to Reader's Quiz (November, *Electrical Contracting*, Page 152) our problem consisted of controlling six 200 hp. squirrel cage motors from a remote point. Each motor was used to drive a deep-well pump, the first of which was approximately one and a quarter miles from the remote control point. The other five pump-stations were spaced on about 2000 foot centers and were beyond the first well. Three phase power at 440 volts was available at each pump-station in addition to 110 volts single phase from the control transformers for operating the magnetic starters.

At the remote control station, we had available 120/208 volts, 60 cycles and 125 volts d.c. from a battery. In addition to start-stop control from this point, we also wanted lamp indication as to whether or not each motor was running. We wished to do this of course with the minimum number of conductors and at minimum cost. We also were seeking as simple and positive a control scheme as possible.

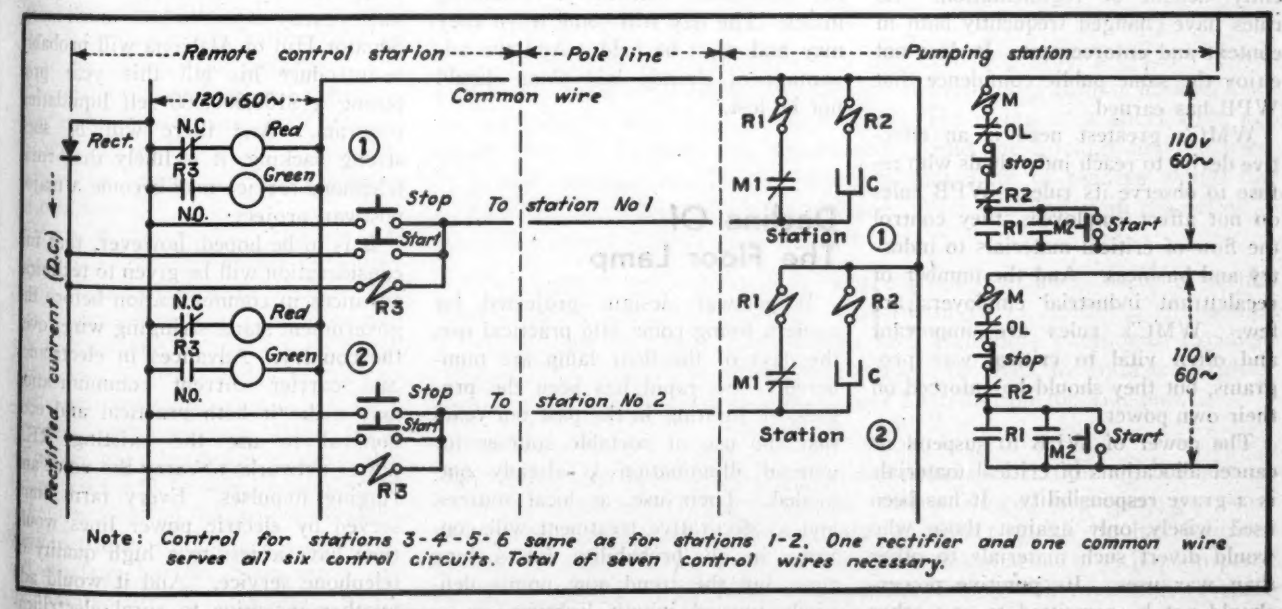
My final solution is seen in the accompanying sketch. A common wire and a common rectifier is used for all six control circuits. Only one line wire is required to each pump station making a total of seven wires to be carried over the first one and a quarter mile of pole line to the first station.

Relays R1 at the pump-station and R3 at the control station are connected series and feed from the rectifier through to the common wire. By taking the circuit resistance into consideration and by selecting and calibrating the relays, R3 will pick-up, but R1 will not. Thus, R3 is energized (by d-c) from the rectifier, through the control wire to the pump-station, through the normally-closed contact M1 (motor not operating), and through the relay coil of R1 to the common return. Note that the parallel circuit (at the pump-station) containing relay coil R2 and the capacitor C is the same as an open-circuit when operating from the rectifier since a capacitor will not pass direct current.

Under these conditions, the motor is not running, R1 is partially energized but does not have enough voltage to pick-up, R3 is fully energized and picked-up so that the normally-open R3 contact is now closed and the green light is illuminated.

Pressing the start button by-passes R3 and gives R1 sufficient voltage to pick-up, closing R1 contact in the control circuit of the motor starter. Energizing M closes the 440 volt motor circuit contacts (not shown), closes the holding circuit contact M2, and opens the normally-closed contact M1. The opening of M1 de-energizes both R1 and R3 which permits R3 normally-closed contact to close lighting the red light indicating that the motor starter is closed and the motor is operating. Any trouble at the well such as an overloaded motor, a short-circuit or other trouble will trip the motor off the line, close contact M1, energize R3, which in turn lights the green light on the control board for that particular motor, indicating that it is not running.

To stop the motor from the remote control station, the operator pushes the stop button which closes the a-c 120 volt 60 cycle circuit to relay R2. The capacitor, which is designed to pass enough 60 cycle current to operate R2, opens R2 contact in the stop circuit of the motor. De-energizing M closes the normally-closed M1 contact, energizing R3 which turns the red light off and the green light on.



Note: *Control for stations 3-4-5-6 same as for stations 1-2. One rectifier and one common wire serves all six control circuits. Total of seven control wires necessary.*

***REMOTE CONTROL SCHEME** used by a Texas contractor for remote control of six 200 horsepower squirrel cage motors driving deep-well pumps.*

EDITORIALS

W. T. Stuart, *Editor*

Restrictions Are Not Penalties

Violations of War Manpower Commission rules can now be enforced by withdrawing priority ratings and allocations. The War Production Board recently issued a directive to that end, a new and possibly serious complication to the already overwhelming complexity of administrative law under which business goes on today.

Such a move at this time is unfortunate and unnecessary. There is, generally, wide and universal compliance with WPB rules. Industry has learned to work under them. WPB men have learned how to administer them. There has been mutual confidence and understanding. Violations have been dealt with vigorously and severely. Altogether the War Production Board stands far above other administrative agencies and it has the wholehearted support and respect of the people.

WMC, on the other hand, carries out an administrative operation dealing with people. It is beset by shrinking resources of skilled men, labor strife and a population which through all history has been belligerently defiant of regimentation. Its rules have changed frequently both in context and enforcement. It does not enjoy the same public confidence that WPB has earned.

WMC's greatest need is an effective device to reach individuals who refuse to observe its rules. WPB rules do not affect employees, they control the flow of critical materials to industry and business. And the number of recalcitrant industrial employers are few. WMC's rules are important and often vital to critical war programs, but they should be enforced on their own power.

The power of WPB to suspend or cancel allocations of critical materials is a grave responsibility. It has been used wisely only against those who would divert such materials to other than war uses. Its punitive powers should not be permitted to any other agency.

Conventions Are Out

Many meetings, long scheduled for the coming months of 1945, have been cancelled at the request of Washington. The test is no longer whether or not a meeting contributes to the war effort, but how much serious harm the war effort will suffer if the meeting is called off.

It is very unfortunate that some of our own industry meetings cannot be held. Because of their industrial and economic significance, they are a lot more important than many social, fraternal and other conventions that have filled hotels and railway space and at which the recent order curtailing meetings is unquestionably directed.

It is especially unfortunate that meetings which will have a direct bearing on the creation of postwar business and jobs must be deferred. But the war requirements on transportation facilities come first and ODT will find our industry cooperating in every way to help.

Many of the meetings planned for this year are so important, however, that they should not be cancelled outright, but postponed indefinitely with the committee machinery remaining intact. The day will come when they may and must be held. And the advantage of already laid plans should not be lost.

Decline Of The Floor Lamp

If postwar designs projected for modern living come into practical use, the days of the floor lamp are numbered. So rapid has been the progress of lighting in the past ten years that the use of portable sources for general illumination is already outmoded. Their use, as local sources, and as decorative treatment will continue in all probability for a long time, but the trend now points definitely toward inbuilt lighting.

"Homemakers don't want bright lights". We have come to accept that as a barrier to better home lighting. It is true. But it is not a limit on good home lighting. It is a challenge to skillful design and installation. We know from experience that the housewife who would refuse to install 60 watt lamps in wall brackets may have one or more floor lamps in the living room. They will accept light, all we can give them, but they don't want brightness in the lighting fixtures.

Modern, large area, fluorescent fixtures, cove lighting and similar low brightness lighting technique providing high illumination intensities are yet to be applied on a large scale to residential lighting. They may easily revolutionize our concepts of modern living. They will certainly reduce the floor lamp to a subordinate role in home lighting.

Farm Telephone Service Next

Extension of telephone service to rural areas on a par with REA power can be considered imminent. There is already talk in the Congress of a Rural Telephone Administration and, postwar, we may expect to hear much more. Senator Hill of Alabama will probably re-introduce his bill this year proposing a $100,000,000 self liquidating program. And there will be such strong backing, it is likely that rural telephone service may become a major postwar project.

It is to be hoped, however, that full consideration will be given to technical advances in communication before the government starts stringing wires over the country. Advances in electronics and carrier current communication may make it both practical and economical to use the existing REA power networks to carry the voice and ringing impulses. Every farm home served by electric power lines would then have access to a high quality of telephone service. And it would add another incentive to rural electrification.

Washington Notes

▸Every war agency is grasping the opportunity offered by the turn-about in public attitude during the past two months to clamp down restrictions, warn of scarcities and strengthen controls. Rules for manpower and materials control which would have encountered critical opposition last November are being accepted uncritically today. The armed services are in the driver's seat. In all probability they will get whatever they want.

Some observers feel that the cry of ammunition shortage in the front lines due to reduced effort at home has been overdone. Pinned down, top men admit that their primary concern is for future supplies and meeting the tremendously increased demands for such items as mortar shells and truck tires.

In any case a renewed drive for greater production is under way, coupled with increased demands for men by the armed forces.

▸As of mid-January, WPB construction forecasts are based on an assumption that war on both fronts will continue through the year. A total of $3,250,000,000 is predicted, the lowest since 1935 or only 24 percent of the peak 1942 volume.

Of this, purely military requirements are expected to be a third less than 1944 for both industrial and non-industrial construction. Essential civilian and indirect war construction will approach the 1944 levels, they say.

▸Present WPB plans for V-E Day and after anticipate no wholesale scrapping of L and M orders. Materials control under CMP will continue. Emphasis will be placed on the most needed civilian goods rather than on broad reconversion of industry.

▸Essential classifications affecting men in the 26 to 30 year draft brackets include electricians. (The complete list will be found in the news columns of this issue.)

▸Much of the drive for manpower is based more on concern for the future than immediate critical needs. The day to day changes in manpower supply and demand confuse efforts to pin down specific needs today or forecast the requirements to come.

▸The "brown-out" is here again. Whether any significant quantities of scarce coal will be saved is a question. The combination of severe weather, serious transportation delays and overall shortage has the Solid Fuels Administration jittery. Window lights, too, must be extinguished.

ABOUT THIS ISSUE

MODERNIZATION of the electric motor repair shop is one of the important industry phenomena of recent years. Much has been done to streamline processes from cleaning and disassembly to repainting and shipping. Orderly procedures for job records, stock-keeping, billing and other paper work have cut costs and losses. Modern machinery has taken the place of handwork. The process was under way long before the war, but manpower shortage and increased work have accelerated it. Reed Electric Company in Los Angeles, which handles over 10,000 motor rewinds a year—hence the title of our lead story by Southwest Editor Henry Young this month on page 49—is one of the shops which has installed methodical work flow as an aid to faster and better output on a large volume business.

When we first heard about plans for a new school to be set up by IBEW at Marquette University to train electricians in electronics, we figured it would be news of considerable importance. It turns out to be more than that. Apparently history is in the making, not only for labor, but for the whole industry. Selected men are sent to school there, then bring back this learning to their own locals. Middlewest Editor Gus Eckel went to Marquette, sat through classes, listened in on bull sessions, asked a lot of searching questions, took pictures all over the place and banged out a story—Electronics for Electricians, page 52, which is not only smart reporting, but mighty interesting reading.

Whether you've lived with lighting since the St. Louis Fair, or have just started to learn about lumens, Cooper's series on Lighting Techniques, which started in January, will provide useful data. Getting down to fundamentals, he tells us to start at the lighting result wanted and work back from there. Cooper becomes Eastern Editor of *Electrical Contracting* this month. His series will continue and he will be developing many other authoritative articles in this field.

Recharging dry cells?—we didn't believe it either. Puncturing the case and soaking in salt water and such old rejuvenators we once used but plain recharging won't work. So at North American Aircraft some less skeptical folks tried it and made it work, on thousands of cells. Hence—Doubling Dry Cell Life on page 62.

L. R. Bagwell of Houston sent a question to Reader's Quiz. It was published and several answers came in. It involved a control arrangement for six 200 hp. deep well pump motors. He wrote us a short time ago about how the problem was finally solved and the hookup that he used. It proved so ingenious that we thought that a lot of readers would like to have the advantage of his experience. You will find it in the article—Remote Control Scheme—on page 69.

What with fluctuating loads and unpredictable demands, welding circuits seem a natural for the loop circuit. Contractor W. G. Stockhausen installed a loop system for welder distribution at a Baltimore plant with excellent results. The story, with wiring diagram and pictures, by Industrial Editor Bob Miller, is on page 56—Load Center Distribution for Welders.

Explosion-proof wiring is a subject of keen interest in these times, not only because of the great expansion of the chemical industry, but because of its increased use around hospitals. Glenn Rowell is preparing a story for us on hospital explosion hazards, a subject which he has followed closely for many years. And an industrial installation of explosion-proof wiring is just off Bob Miller's typewriter. You will find both of these timely stories in forthcoming issues.

BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

PRACTICAL METHODS

COMPOUND REDUCES CORD MAINTENANCE

MAINTENANCE

Plugs on the ends of extension cords and hand-tool cords had been the source of much trouble at the Douglas Aircraft plant in Santa Monica, California, until Charles W. Silver came along with an idea to alleviate the situation. Dirt, dust and foreign matter such as cuttings from drilling operations, often became shorted between the prongs of the plug necessitating replacement and involving lost production time. In addition, rough handling often caused breakage of the prongs.

WOODEN JIG holds plugs in position for filling. Tar compound is heated in ladle by cone heater.

Mr. Silver's idea which has been adopted as a standard maintenance procedure, has reduced the troubles to a minimum by simply filling the open space within the plug (after connections have been made) with a tar compound. In this way a smooth surface is obtained over the open end of the plug so that foreign matter cannot collect. In addition, the compound has added strength to the prongs and materially reduced breakage of prongs and wire connections both.

A jig for holding the plugs in an upside-down position while pouring the compound speeds and facilitates the operation. The jig consists of a two-by-four that has been drilled, countersunk to hold the plug, and slotted to accommodate the cord.

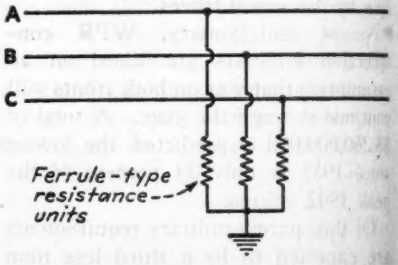
BLEEDER PLUGS ELIMINATE FLASH-OVERS

WIRING

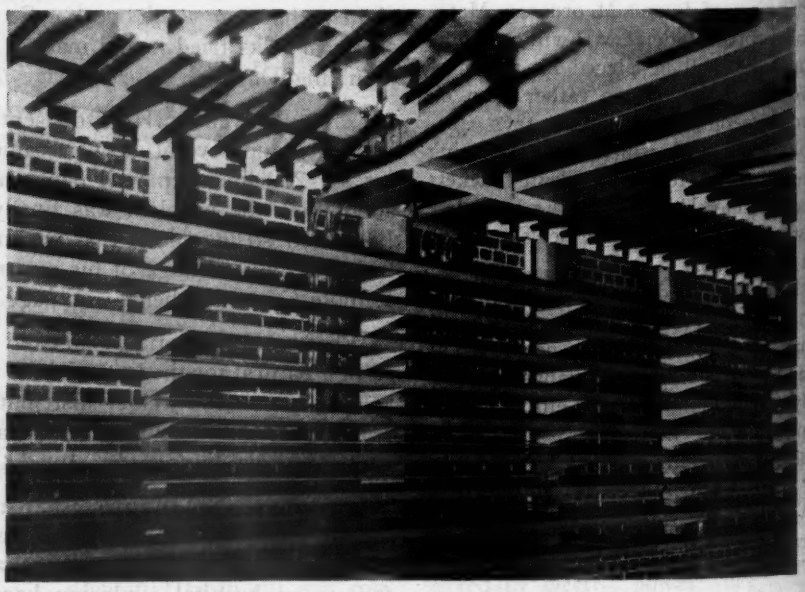
When the wheels began turning at Chrysler Corporation's Dodge-Chicago plant, where engines for the B-29 super-bombers are being turned out daily, the electrical department encountered a few headaches with flash-overs in the plug-in units feeding the machine tools from the 440-volt, 3-phase bus duct distribution system. Plant engineers investigated and discovered that transient and static voltages had been building up along the duct runs and after reaching a certain value would cause the annoying flash-overs.

Their solution to the problem was to install neutralizer (bleeder) plugs which would provide a discharge path for such voltages. One such plug was installed on each run of bus duct (average, 400 feet per run). From that time on they have had no more trouble with flash-over conditions.

The neutralizer plug is nothing more



DIAGRAMMATIC SKETCH showing the electrical connections of the neutralizer plug which provides a discharge path to ground for transient and static voltages that might build up in bus duct runs.



SEPARATE TRAYS are used to carry the control wires of each rectifier in the New York City Aluminum plant. The control cable coming from the unit is carried across under the rectifier room floor and can be seen running at right angles to and above the wall trays located in the basement. They are then carried in these wall trays to the central control panel.

ADV.

SYLVANIA NEWS
CONTRACTOR EDITION

FEBRUARY *Published in the Interests of Better Sight and Sound* 1945

New "Long-Slim" Fluorescent Lamps Will Soon Complete Sylvania Line

Instant-Starting Type Will Open New Sales Markets in Commerce, Industry

New fluorescent lamps soon to go into commercial production at Sylvania Electric are expected to open up broader markets for installation of fluorescent lighting. Production of these lamps will make available to contractors a complete line to meet every fluorescent lighting need.

Outstanding among these additions to the Sylvania line are four long, small-diameter lamps of the instant-starting type, requiring no starter. ¾" diameter lamps will be produced in 42" and 64" length; 1" diameter lamps in 72" and 96" lengths. All will use a single-pin base.

These lamps will have a number of important features, which will assist contractors in promoting their use in many new fields of application.

From the standpoint of appearance and adaptability, their small diameter is a definite advantage, particularly in such uses as showcases, coves and display lighting. The longer units are of special interest in continuous-row applications, where they allow maximum length uninterrupted by mounting equipment.

An entirely novel feature of these new lamps is that they can be installed for operation at either of two current ratings, by proper selection of the ballast. Operation at the lower current rating results in low brightness. This feature is particularly desirable in narrow corridor areas, small showcases, and for many decorative purposes.

The lamps will require new sockets and ballasts, which, because of wartime limitation, are not expected to be available for several months. The lamps themselves are now available in sample quantities, and the technical data published below will be of value in preliminary planning for their use in future installations.

NEW MINIATURE LAMP

Also being added to the Sylvania line is a 21" lamp, ⅝" in diameter, rated at 13 watts. This lamp is of the conventional starting type, and uses a standard miniature bipin base.

The addition of these new lamps to Sylvania's extensive list of standard and miniature fluorescents will place contractors in an excellent position to promote fluorescent for every purpose.

THE NEW ADDITIONS TO SYLVANIA'S FLUORESCENT LINE

LONG-SLIM LAMPS	CURRENT MILLIAMPERES	APPROX. INITIAL LUMENS	LAMP LIFE HRS.
42" T6 (42", ¾")	100 200	900 1400	Life of Long-Slim fluorescent lamps at 200-milliampere operation is expected to be comparable to that of 40-watt standard fluorescent lamps. Definite ratings will be published as soon as life testing is conclusive.
64" T6 (64", ¾")	100 200	1400 2150	
72" T8 (72", 1")	100 200	1400 2350	
96" T8 (96", 1")	100 200	1950 3300	

MINIATURE LAMP	CURRENT MILLIAMPERES	APPROXIMATE INITIAL LUMENS	LAMP LIFE, HRS.
21" T5 (21", ⅝")	160	Daylight . . . 490 White 580	1500 on a 3-hr. Cycle

*Under specified test conditions

SYLVANIA ELECTRIC

SYLVANIA ELECTRIC PRODUCTS INC., Salem, Massachusetts

MAKERS OF FLUORESCENT LAMPS, FIXTURES, ACCESSORIES; INCANDESCENT LAMPS; RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES

than a device which incorporates three resistance units, each connected between a phase of the duct bus and the metal enclosure (ground) which is normally grounded. Resistance units are of the ferrule type to facilitate easy replacement in case of failure or burnout. Based on a total of some 48,000 feet of distribution bus duct in the plant buildings, there are approximately 120 of these bleeder plugs installed on the duct runs.

MOUNTING CABLE ON SHIPBOARD

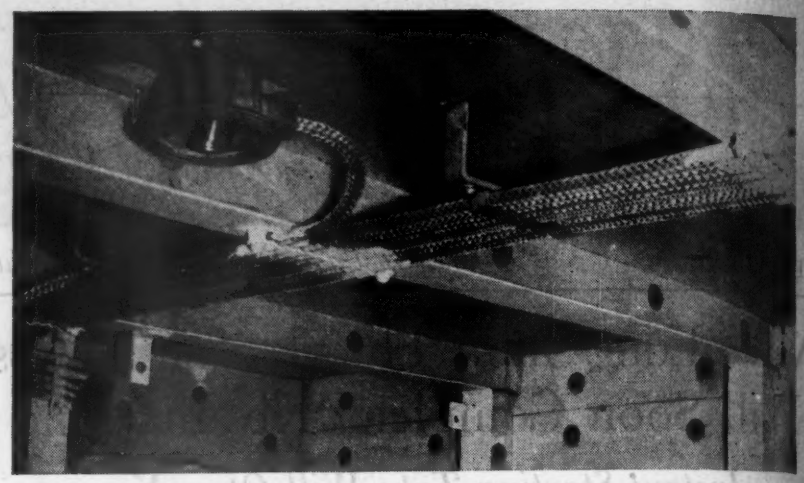
WIRING

Marine wiring differs from conventional "land" wiring with respect to type of cable employed and specific techniques for mounting equipment. The insulated conductors of the cable are encased in a protective lead sheath which is wrapped with a fabric tape. This, in turn, is enclosed in a tight-knit, basket-weave, copper jacket designed to afford added protection against mechanical injury and exposure to the elements. This heavy construction of the cable makes it less "workable" and more difficult to handle than the conventional cable used in building construction or underground installations.

Marine cable, being generally mounted exposed to the interior of the ship's hull, bulkheads, and the underside of the decks, requires mounting straps at relatively short intervals. Normal shipwiring practice prohibits drilling the steel to install cable, outlet boxes or equipment. Welded construction is the accepted method of mounting these items. But, cable circuits and outlets should be installed in such manner as to facilitate quick removal and replacement in case of a failure—a specification suggesting the use of screws.

Steel brackets and "pads", drilled and tapped to accommodate machine screws was the answer to the problem. These brackets and pads are welded to the ship structure at the required intervals and the outlet boxes and cable straps mounted thereon. This method (see accompanying photo) was used by Tri-State Armature and Electric Works, Memphis, Tenn., while wiring almost 200 LCT craft.

To simplify tracing of circuits and easy removal of a single cable, the grouped cables are mounted side-by-side in a horizontal plane—seldom one on top of the other, except in very cramped quarters where they cannot be spread out. Thus, it is not uncommon to see a group of ten or twelve cables paralleled in the same plane.



WELDED BRACKETS and steel pads, drilled and tapped to accommodate machine screws, provide a means of mounting marine cable and fittings to the ship structure without drilling the steel and bulkheads. Outlets are fitted with soldered packing gland nipples to water-proof cable terminals.

Marine type outlets are also screw-mounted to welded "pads" and are equipped with conduit nipples silver-soldered to the outlet box. This provides an entrance for the basket-weave cable and serves as a packing gland for water-proofing the cable terminal.

FOOT-SWITCH FOR MOTOR CONTROL

INDUSTRIAL

Modifications for the standard Farnham Roll Forming Machine developed by The Glenn L. Martin Company, Baltimore, Maryland, have not only tripled the productivity of this equipment used to produce cylindrical contours in heat treated aluminum alloy sheet: but in addition, have eliminated a serious safety hazard, reduced scrap to zero, and simplified the operation sufficiently to permit the use of semi-skilled operators. The modifications were designed by the Tool Design Electrical Group under the direction of Paul H. Merriman.

There are three principal changes. Foot switches have been substituted for the old rope control to stop, start and reverse the motor. A solenoid brake has been added to permit instantaneous stopping at any point. Remote safety stop and lock out buttons have been installed at convenient points over the length of the machine to permit its safe use by more than one operator.

The Farnham machine, as originally equipped, was controlled by a rope extending the full length of the machine connected to a reversing drum switch near the motor. To operate the machine in one direction the operator had to pull the rope in the desired direction, starting the drive motor. If the operator released the rope, the rolls continued to turn, since the drum switch was not "spring return to off." This represented a definite safety hazard since if the operator found it necessary to support the work with both hands, he lost easy stopping control of the machine. If his hands or clothing became caught in the rolls, severe personal injury was possible unless he was able to find the rope and pull it to the OFF position.

A further difficulty arose from the fact that once the rope was pulled to the OFF position, the motor continued to coast for a considerable period unless the operator pulled the rope to full reverse position and then back to STOP at the instant the motor came to rest. Not only did this add to the safety hazard, but it also necessitated a great degree of skill on the part of the operator in order to stop the ma-

***OPERATOR** uses foot-switch to control Farnham machine leaving the hands free to manipulate work.*

FOR SAFETY'S SAKE . . . USE CONDUIT *(Full Weight Rigid Steel)*

FOR satisfactory performance of duty under all conditions of service... even the most critical will approve this citation of rigid steel conduit.

Neat and orderly appearing! And for strength and endurance, rating is the highest. Dependability in emergencies, 100%.

When Youngstown Buckeye Conduit is "back from the war," you can again employ this veteran protector wherever you need to give your wiring jobs unfailing, enduring protection.

BUCKEYE TRADE MARK YOUNGSTOWN CONDUIT

Ask your distributor for: Youngstown Buckeye Conduit . . . Pipe and Tubular Products . . . Sheets . . . Plates . . . Electrolytic Tin Plate . . . Bars . . . Rods . . . Wire . . . Nails . . . Tie Plates and Spikes

YOUNGSTOWN

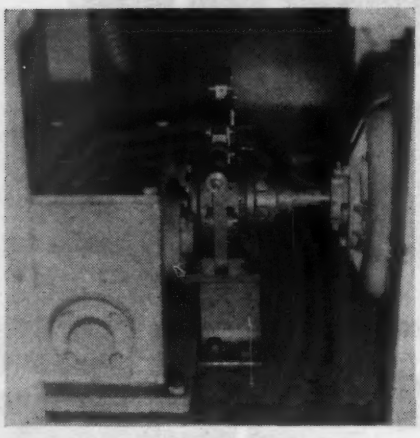
THE YOUNGSTOWN SHEET AND TUBE COMPANY

YOUNGSTOWN, OHIO

Manufacturers of

CARBON - ALLOY AND YOLOY STEELS

CLOSE-UP of foot-switch to control forward and reverse operation of rolls.



SOLENOID BRAKE is installed on coupling shaft opposite motor to provide instant stopping. Leather lining on shoe-face is used to obtain more rapid braking action

chine within a fraction of an inch of specified points while the work was passing through the rolls.

The new modifications completely eliminate these difficulties. The foot switches give the operator positive control at all times while freeing his hands at all times; the solenoid brake provides instantaneous stopping at any point; while the remote control buttons give additional operators the same safety control which the foot switches give to the principal operator.

The foot switch is of an exclusive Martin design and is used in large quantities throughout the company's manufacturing operations. Its salient features are:

1. Operating pedal very close to the floor level, permitting the operator to keep both feet firmly on the ground and operate the switch with his toes (see illustration).

2. The electrical mechanism consists only of a standard microswitch, which is inexpensive, easily replaceable, extremely accurate and requiring low pressure and travel to operate.

3. All moving parts of the switch are balanced dynamically so that sudden shocks or movements will not produce undesired operation.

4. All moving parts are supported on ball bearings to reduce friction and wear.

5. The switch housing has an integral safety cover made of heavy gauge welded steel plate to prevent undesired or accidental operation, is extremely rugged, and will withstand severe abuse.

Since installation of the new modifications, no accidents have been reported on the machines. Scrap losses have been reduced to zero due to the ease of accurate stopping, production speed has been increased to three times what it previously was, and the degree of skill required for the job has been substantially reduced. The cost of the modification was relatively low since all necessary parts were available in the maintenance shop. The installation procedure requires four simple steps—(a) removal of rope control and replacing of drum-switch with reversing magnetic contactor; (b) installation of solenoid brake on motor shaft; (c) installation of control wire conduit along front of machine with outlets for stop button and foot switch cables; and (d) wiring of foot switches and stop buttons into control.

A reduced voltage control transformer may also be used if desired although it is not mandatory. At the Martin Company it is standard practice to use control voltages no higher than 110 on all machine tools in order to reduce the possibility of electrical shocks to the operator.

MOISTURE SEAL FOR ELECTRIC CABLES

WIRING

Navy electrical design engineers have developed in conjunction with Owens-Corning Fiberglas Corporation, a method of sealing against moisture vapor and water penetration the open ends of cables carrying current vital to the operation of fighting ships and their armaments.

The vulnerable point has always been the end of the cable where the cable armor has been removed to permit separation of the conductors for hook-up. This open end is enclosed in a moisture-tight box, but if the box is shattered by bombing or shell fire there is always the possibility that water entering the open cable-end will work down into the cable, causing failure.

Materials required for sealing the cable, independent of the terminal box, are a non-moisture-absorbent wax with a fairly constant viscosity range, Fiberglas tape impregnated with a synthetic rubber compound, and treated Fiberglas

Cable end-sealing showing materials used in construction. Crotch is filled in with moisture-proof insulating compound. Over this compound, a specially treated strip of Fiberglas tape, E, is wrapped at A. Specially treated cord, F, is then applied at B and C working toward center of tape. Compound under stretch-proof tape is forced into the crotch of cable and out toward the ends of conductors, at D, H, and J. Insulating sheaths are then tied down with specially treated cords, G. Different colors are used for circuit identification.

tying cord. Fiberglas tape and tying cord are employed primarily because of their high tensile strength and because they will not stretch or absorb moisture.

Since the glass tape and cord are also non-inflammable, this modification of the end of the cable does not destroy its flame resistant characteristics. The first step is to skin back the cable armor a short additional distance from the end, further exposing the interior conductors. The filling wax is then built up around the conductors, at the crotch. The conductors are pulled together and tightly wrapped as a unit, with strips of tape four to six inches wide. Cord is then applied from both ends toward the middle of the wax section. The resulting pressure forces the wax back into the core of the cable, forming a solid vapor-and-moisture-proof seal.

DESTRUCTIVE EFFECT OF HIGH TEMPERATURE SOLDERS ON COPPER WIRE

INDUSTRIAL

Conclusive evidence that commonly used high-temperature molten solders have a destructive effect on copper wire has been discovered by engineers of the Fairchild Camera & Instrument Corporation, N. Y.

While conducting tests that resulted in the finding of a new method for clean-stripping Formex type insulation from fine wire (sizes 36 to 44), Fairchild engineers explored this in-

RELIGHTING WITH ARISTOLITES*

Glass-Diffused Fluorescent Lighting... Modern... Super-Efficient

Guth ARISTOLITE Fluorescent Aristocrat Installed in the Offices of The Pittsburgh Press Pittsburgh, Pa.

"AFTER" ▼

"BEFORE" ▼

"Lighting Miracle" is Performed!

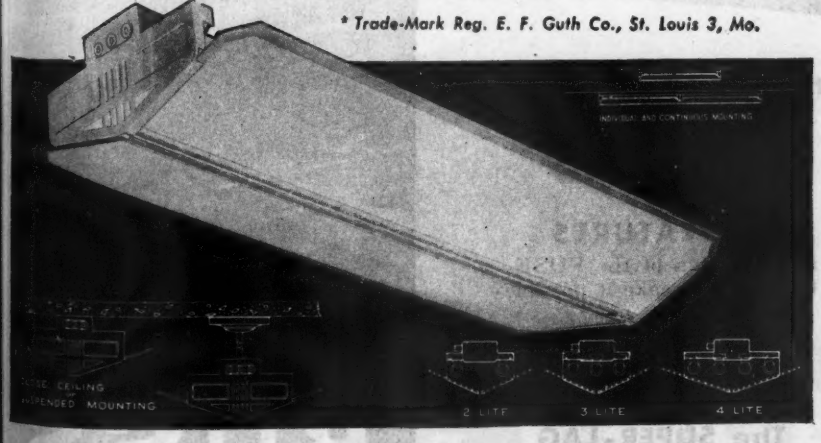
From 8 to 34 Foot Candles

WITH NO INCREASE IN WATTAGE!

NOW as never before, greater and better illumination is available at low cost, with the GUTH ARISTOLITE. The "Before" and "After" photographs show results of modern light-conditioning for the fast-moving, accurate editorial staff of the Pittsburgh Press, Scripps-Howard Newspaper in Pittsburgh, Penn. MORE THAN FOUR TIMES AS MUCH LIGHT is now provided—AND NOT ONE MORE WATT OF CURRENT IS REQUIRED!

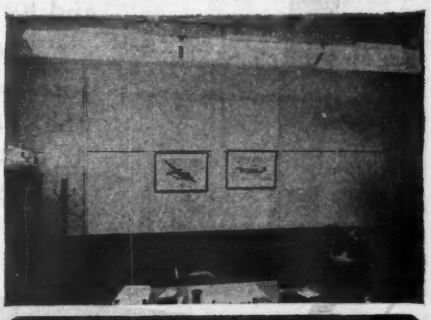
In commenting on this job, the Graybar Electric Co., of Pittsburgh, who engineered the installation, said "Management is very well pleased. Like the lighting results, and the fixture construction. Installation costs were only 50% of the amount estimated."

* Trade-Mark Reg. E. F. Guth Co., St. Louis 3, Mo.



INSTALLATION DATA

Fixtures are mounted on 9' 0" x 10' centers, and are dropped 2' 0" from the 12' 0" ceiling. The old Prismatic-Glass Fixtures used 200-watt lamps, produced 8 foot-candles. The new GUTH ARISTOLITES, with four 40-watt white fluorescent lamps, deliver 34 foot-candles. Same wattage for each installation.



FOR PRIVATE OFFICES, TOO!

Three 4—40-watt ARISTOLITES suspended 10' 0" above floor, and joined end-to-end, provide 40 to 45 foot-candles of diffused illumination on the desk-top. Engineered by Mr. L. D. Lyon, Consumers Power Company; sold by Electric Wholesale Supply Company, both of Jackson, Michigan.

ARISTOLITE DATA

ARISTOLITES are made for 2, 3 or 4 rows of 40-watt lamps. They are 48⅛" long; the 2 & 3 light sizes are 12½" wide, and the 4-lite is 17½" wide. They can be installed as individual luminaires or in continuous runs; they are for close-ceiling mounting, or can be suspended on hangers. Lighting is diffused through efficient, ornamented design glass-shields, which are set at angle to allow loose dirt, bugs and dust to roll-out. Uplight is provided to "Soft-Light" the ceiling. Die panelled, light-windowed endplates complete the ARISTOLITE design.

THE EDWIN F. GUTH COMPANY • 2615 WASHINGTON AVE. • ST. LOUIS 3, MO. Guth

"Not a Single Main Line Fuse Failure in Three Years—*Since We Switched to BUSS Super-Lag*"

Says **MR. C. E. TUFTE, President Elkhart-Moraine Sand & Gravel Co. • Elkhart Lake, Wisconsin**

"We had been having too much trouble on our main circuit, protected by 600 ampere, 440 volt renewable fuses. On an average of once a week this circuit was shut down because fuses went out due to temporary overloads. An extra heavy load in crushers, or the simultaneous starting of several motors would cause a temporary overload and a fuse would blow. This unnecessary blowing of fuses produced a very aggravating situation—left workers idle—shut down production—and lost money for us.

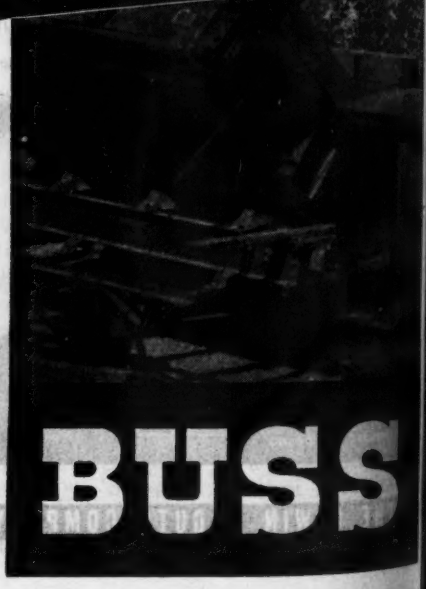
"Then, three years ago, we switched to Buss Super-Lag fuses—*and we haven't had a single failure since.* What a relief that has been. And today's operating conditions are tougher than they were three years ago, because our production is greater, with less time for maintenance and repairs."

Why BUSS Fuses Don't Blow Needlessly

10 FEATURES
in the design of the FUSE-CASE help make it possible.

and

The SUPER-LAG
development in the FUSE-LINK completes the job.



BUSS

You, too, can get relief from production breakdowns due to fuse failures. The solution to your problem is just as easy as it was for Mr. C. E. Tufte at Elkhart-Moraine Sand & Gravel Co. BUSS Super-Lag fuses provide the extra-time lag to protect against harmless surges, yet give complete and adequate protection.

Buss fuses require no maintenance or periodic inspection. They don't open needlessly. If one opens, you can be sure some condition needs correction. When one opens, it requires less than 45 seconds to renew with an inexpensive link.

Here Is Why BUSS Fuses Greatly Reduce or Entirely Prevent Needless Blows

The fuse case is designed to insure good contact on the link, even when the fuse is renewed by an inexperienced person—and it is so designed that vibration or heavy overloads or the constant heating and cooling of the fuse will not permit poor contact to develop. Thus excessive heating, which causes fuses to blow needlessly, is prevented.

The fuse link used is the famous "BUSS Super-Lag." It has lag-plates attached to it. These give it a time-lag so long that it will reduce to an extent not possible with any other renewable fuse, the number of shutdowns caused by needless fuse blows.

How to solve the "shutdown" problem

Pass the word along that all purchase records dealing with circuit protective devices should be immediately changed to call for BUSS Super-Lag Renewable fuses. Then, as fuses are replaced or new installations made, your plant will automatically get the benefit of the carefree, trouble-proof protection that BUSS Super-Lag fuses afford.

BUSSMANN MFG. CO., University at Jefferson, St. Louis 7, Mo.
Division McGraw Electric Company

Super-Lag FUSES SOLD THROUGH WHOLESALERS

MOTOR SHOPS

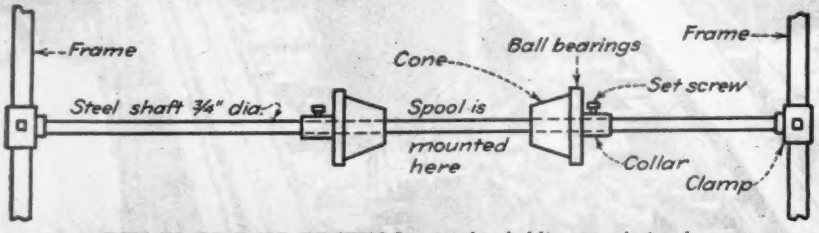
ADJUSTABLE BEARINGS FOR WIRE SPOOLS

Holes in wire spools vary. If they do not run true on the shaft, at high speeds especially, the wire jerks and slaps when paying off to wind coils. This is not only annoying but cuts down the safe running speed.

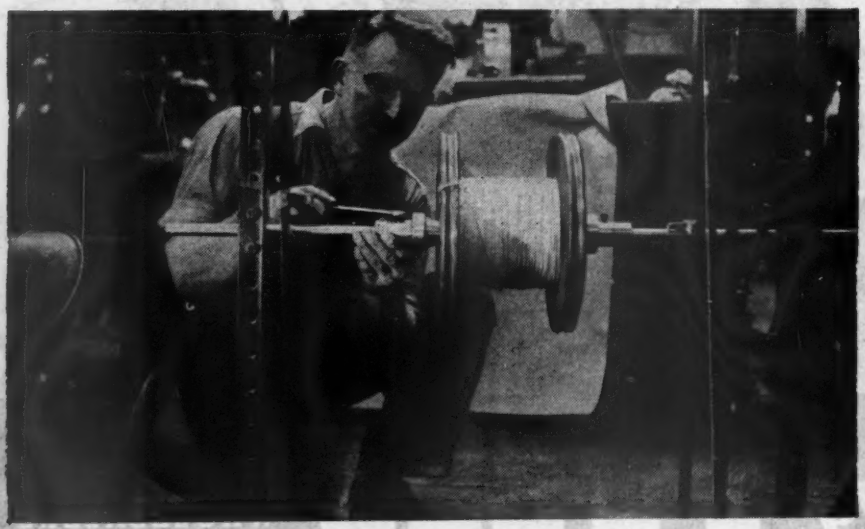
In the shop of Kuchel & Sievers, San Francisco, B. W. Ames, foreman has recently designed and constructed an adjustable, ball-bearing device which gets around the difficulty and the wire pay-off is smooth as silk at high speeds.

There is a steel shaft ¾-in. in diameter, which is clamped on the frame and carries the spool or reel. The latter, however, does not run directly on the shaft but on two cones which are thrust into the holes in the spool and seated so that there is no play.

The cones run on ball bearings attached to metal collars, which are mounted to slide readily on the shaft and fixed in place with set screws after the cones have been fitted into the spool.



***DETAIL OF BALL BEARING** cover for holding spools in place.*



***SPOOL HOLDER**, adjustable for different reel sizes, hold reel centered and tight on pay-off rack.*

GAS-FIRED CLEANING TANK

The gas-fired cleaning tank in the Stark Electric Company motor shop, Baltimore, Maryland, has been built big enough to handle the large marine equipment which comes in for maintenance and repair (in addition to other industrial motor work).

Oakite and water solutions, brought up to a high turbulent temperature, does the job of de-greasing and removing varnish and other foreign matter from stators, armatures and mechanical parts.

Sheet-metal duct work carries fumes from the partially-enclosed burner beneath the tank to the outside. Natural draft, damper controlled provides sufficient draw to take away the fumes.

The tank itself is three by six by three feet deep. Angle iron legs hold the tank two feet off the floor to facilitate drainage of used solutions. The tank lid is hinged to avoid having to handle the heavy top piece.

A mono-rail carrying a two-ton chain hoist is mounted above the tank with extensions on both ends; that is, the rail extends in one direction to enable the hoist to carry pieces outside over a concrete apron for hosing down, and extends in the other direction to carry them back into the shop proper.

***TWO-TON CHAIN HOIST** lowers a large stator into the cleaning tank for removal of varnish from iron.*

COIL WINDER FROM OLD ENGINE LATHE

C. A. Hoelle, foreman of the Hagerstown Equipment Company, Hagerstown, Maryland, and a very ingenious fellow, has converted an old engine lathe into quite a flexible coil winder.

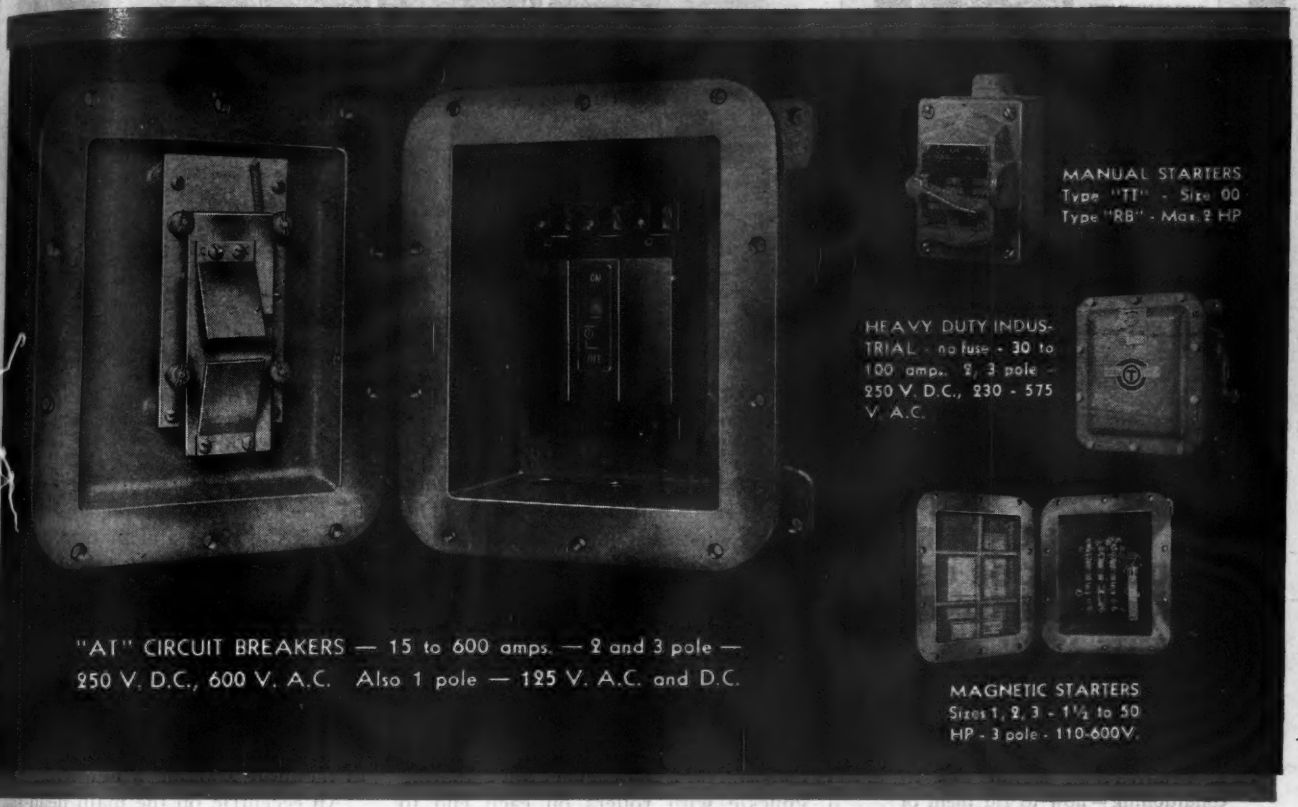
The head and back-gear of the fourteen-inch lathe has been reversed, providing a face-plate extending over the end of the bed. This permits a winding head to be attached.

A Chevrolet transmission, mounted on an angle-iron rocker-bed frame, is used to drive the lathe head. This provides three speeds ahead and one in reverse. In addition, the three-step cone pulley gives a variety of different speeds both forward and reverse. The transmission case carries a double-ended shaft for a flat-belt head-drive pulley, and a twelve inch V-belt pulley to transmit the incoming power.

The V-belt carries a four-to-one reduction from the gear transmission unit to the motor. The driving motor is rated 1½ horsepower and is wound rotor in construction. It is provided

TRUMBULL

EXPLOSION-PROOF EQUIPMENT


MANUAL STARTERS
Type "TT" - Size 00
Type "RB" - Max. 2 HP
HEAVY DUTY INDUSTRIAL - no fuse - 30 to 100 amps. 2, 3 pole - 250 V. D.C., 230 - 575 V. A.C.
"AT" CIRCUIT BREAKERS — 15 to 600 amps. — 2 and 3 pole — 250 V. D.C., 600 V. A.C. Also 1 pole — 125 V. A.C. and D.C.
MAGNETIC STARTERS
Sizes 1, 2, 3 - 1½ to 50 HP - 3 pole - 110-600V.

Enclosures are precision made of heavy cast semi-steel . . . designed to assure adequate protection and built to withstand all conditions of heavy duty explosion proof service.

Covers are bolted to box with metal-to-metal, accurately machined matching surfaces assure a tight contact.

Circuit breakers have front operation. Switches can be locked "on" or "off".

Enclosures are designed to allow comfortable space all around enclosed mechanisms for wiring inspection or removal.

Heavy corner mounting lugs immediately accessible, facilitate installation and grouping of units.

All enclosures are attractively finished in machine grey. They add to the appearance of your installations.

THE features incorporated in Trumbull Explosion Proof Enclosures (NEMA Type 7, NE Code Class 1, Group D. Also Class II, III and IV) assure maximum safety where it is necessary to install Circuit Breakers, Magnetic Starters or Switches in atmospheres containing gasoline, petroleum, naphtha, alcohol, acetone, lacquer solvent vapors, and other volatile liquids.

In design and construction special emphasis has been given to LONG TERM safety . . . extra strength, simple design, elimination of possible human error in installation, inspection or maintenance. Write for Trumbullaid Circular No. 315.

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A GENERAL ELECTRIC ORGANIZATION

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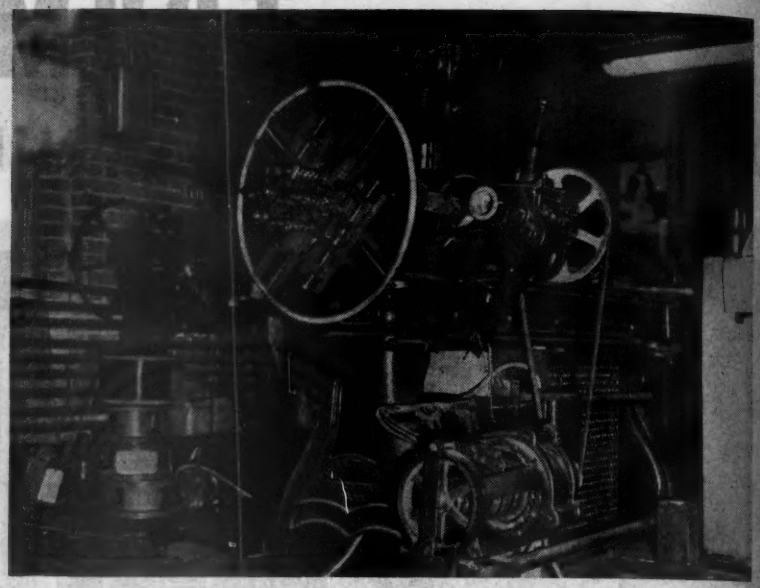


ENGINE LATHE is converted into a variable speed coil winder. Chevrolet transmission, cone pulley and wound rotor motor provide a combination of many forward and reverse speeds.

with resistance control to give further variations in winding head speed. The motor slide-rails are mounted at a slight angle from the vertical and directly on the back of the lathe frame. The magnetic breaker is mounted along-side the motor while the drum controller is attached to the front side for the convenience of the operator.

The braking mechanism can be seen in the accompanying photograph and consists of a foot-lever, an actuating knuckle with rollers on each end to spread the band, and a suspension frame to hold the band off the pulley top-side when running.

Normally, the brake is applied with the foot-lever released. Stepping on the lever rotates the release knuckle, spreads the band and in turn releases the brake. At the same time an extension lever operates a two-wire momentary contact push button which starts the motor. Releasing the foot-lever releases the push button and applies the brake which stops motor and winding head simultaneously and instantly. In this way "inching" can be obtained to facilitate starting a new coil.

An eccentric on the main head-shaft actuates a series of levers which in turn operate a mechanical counter. The counter can add up to five places and can be reset merely by pushing a button.

OUTDOOR MOTOR SHOP LAYOUT

Climatic conditions permitting, this shop plan for partial outdoor operation, recently completed by the Dahl-Beck Electric Co., marine electrical contractors of San Francisco, may appeal to others.

While such operations as coil winding, commutator work, etc., are carried on in the main building, this outdoor shop is used for heavy equipment assembly and cleaning, in which latter

OUTDOOR SHOP for heavy apparatus cleaning permits free use of naptha cleaning fluid.

Vinylite

TRADE MARK

Outspinning the spider

The spider is an engineer—a master of construction and design. While man piled massive stone on stone for the pyramids, the spider built with an extruded material of airy lightness and amazing strength—presaged the whole trend of modern practice.

Today, VINYLITE extruded elastic plastics bring this same invaluable combination to wire and cable insulation. With excellent dielectric properties, they permit new thin-wall construction, with notable reductions in the weight and thickness of insulation on electrical conductors. More circuits can be inserted in existing conduits. And to insulation properties unsurpassed by older types, thin-wall insulation of VINYLITE elastic plastics adds unusual resistance to chemicals, oils, grease, and abrasion. It stays flexible at low temperatures – has a very low rate of moisture absorption. Certain types are non-flammable or slow-burning. It can be made transparent or opaque, in an infinite variety of colors.

Insulation made from VINYLITE elastic plastics sets up new standards of life and service for the full range of conductors, from portable cords to power cables. Write Department 51 for booklet VR. It describes all the VINYLITE plastics for wire and cable insulation, and explains the specific advantages of each for different types of application.

BAKELITE CORPORATION
Unit of Union Carbide and Carbon Corporation
UCC
30 EAST 42ND STREET, NEW YORK 17, N. Y.

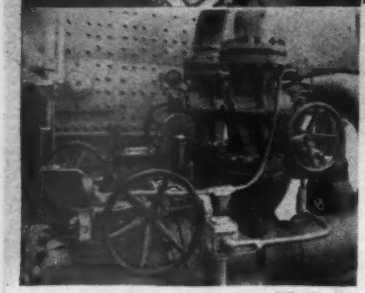
Plastics

CUTLER-HAMMER

MOTORIZED

VALVE

OPERATORS



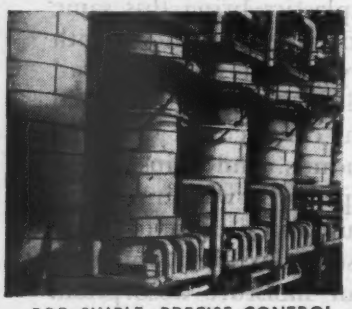
TO CUT BATCHES SHARPLY AND REDUCE CONTAMINATION IN PIPELINE OPERATION

212 Cutler-Hammer Valve Operators on the "Little Inch" pipeline from Texas to New Jersey, uncounted hundreds on other lines, indicate the importance of rapid, fully automatic and centralized control of valves in modern pipeline practice. It gives protection to product quality obtainable by no other means.

for better process control and plant operation . . .

Do you have valves too large, too hot, too "sticky," too hard to reach for efficient operation by hand? Do you need a simple, better or entirely automatic means of controlling valves in complex refining or chemical processes? Do you want instant operation of valves that are yards—or miles—apart? Do you want to conserve time and manpower in your plant? Or are you looking for valve control that not only *starts* any valve but will seat it safely with *positive protection to seat, gate, stem and mechanism*?

You will find what you want in the Cutler-Hammer Line of Motorized Valve Operators. You will find further, that in choosing Cutler-Hammer Valve Operators for the vast majority of installations, their purchasers are simply recognizing the overwhelming importance of dependability and superior engineering . . . the qualities that have always distinguished Cutler-Hammer design. CUTLER-HAMMER, Inc., 1306 St. Paul Avenue, Milwaukee 1, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ont.



FOR SIMPLE, PRECISE CONTROL IN COMPLEX PROCESS INDUSTRIES

The widespread use of Cutler-Hammer Valve Control in high octane refining processes and other chemical process industries demonstrates the gains that result from fully automatic, often inter-locked sequence control of valves.

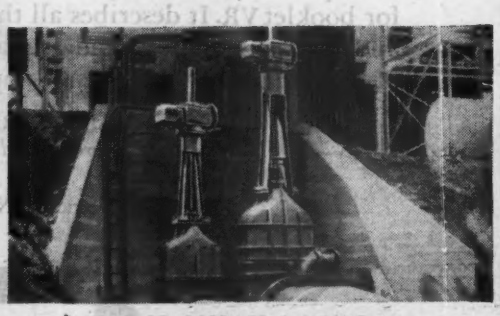
CUTLER-HAMMER

VALVE CONTROL

C-H

WHERE MEN CAN'T GO WHAT MEN CAN'T DO

High pressure, high temperature steam lines and valves often glow red . . . too hot to handle . . . too hard to turn. C-H controlled-thrust-seating operators operate these valves at the touch of a conveniently located push button . . . without danger of jamming.



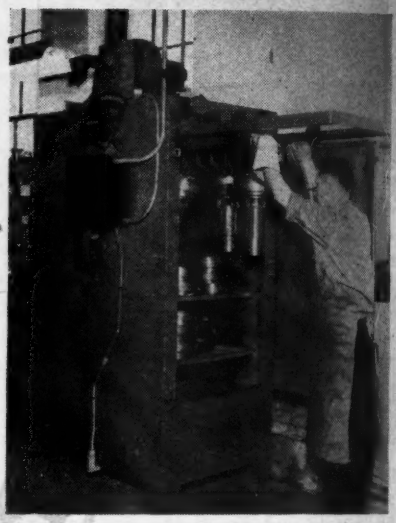
TO OPERATE A VALVE IN THE NEXT COUNTY *NOW*

Distance means nothing to Cutler-Hammer Valve Control. The operation of any valve or any number of valves in the next room, on the next floor, or miles away is immediate, certain, easy . . . a matter of pushing a button located wherever convenience dictates.

operation it is often necessary to use naphtha products as a spray and the fumes are carried off into the air without any special equipment. Compressed air for cleaning purposes is brought to the shop by a piping system on the left-hand wall. The accompanying photograph shows the layout in more detail.

OVERHEAD CARRIAGE ADDS TO OVEN FLEXIBILITY

Remember the time when you had to rig up a special rack on which to suspend small coils and repair parts for a session in the bake oven? It might have been an angle iron affair that slid into the oven; or just a couple of rods resting on the side rails with suspension



LOADING AN OVEN for baking parts at the Electric Machinery & Manufacturing Company in Minneapolis. Note the use of trays as well as the carriage.

READY FOR THE BAKE, these dipped coils are hung on the movable carriage hooks. After carriage is pushed into oven, the access doors and wheel trap-doors close confining all heat to the oven interior. Unit is part of the equipment of the Milford Electric Company, Roosevelt, Long Island.

THE NON-SHATTERABLE LINE

KILLARK ST. LOUIS

FSWRC OUTDOOR WEATHERPROOF RECEPTACLE FITTING for exterior outlets for power tools. Hinged cover for protection against rain. For any standard flush type receptacle.

FB SERVICE CABLE HEAD. For vertical conduit. Cadmium plated. Supplied in 2, 3 or 4 openings. Watertight.

FSWTE OUTDOOR WEATHERPROOF SWITCH HOUSING. Heavy cast iron box for containing standard toggle switch unit.

GF POSITIVE GROUND CLAMP. With exclusive patented safety features for solderless "V" shape clamps for Nos. 4, 6 or 8 bare or insulated wire.

VFCA CEILING OR WALL LIGHT for 3¼" and 4" octagon or 4" sq. outlet boxes. Furnished with globe and without—or with—guard for protected interior farm building lighting.

Type L INSULATOR COVER. Sturdy, composition with five hole "knockouts" for ½", ¾", 1" or 1¼" fittings. Shatter-resistant and highly efficient insulation.

FYL YARD LIGHT complete with 24" of ½" conduit. WFC cast iron fixture cap. FWB pole or GNF wall flange and 12" enamel reflector. A completely weatherproof, outdoor light of great efficiency.

These are only a few of the complete line of Killark Fittings for farm use. With almost 6,000,000 farms unwired, the non-shatterable Killark Line for Rural Electrification qualifies you for your share of sales in your rural community. Don't overlook a single unit of the complete Killark Line—write for literature on Killark Rural Electrification Fittings now.

Killark

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Offices and Warehouses: Atlanta, Baltimore, Boston, Chicago, Denver, Los Angeles, New York, Philadelphia, Pittsburgh, San Francisco, Seattle, Utica.

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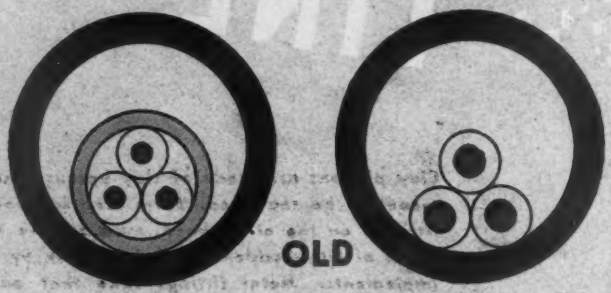
IMPERIAL NEOPRENE JACKETED PORTABLE CABLES

CRESCENT SYNTHOL TYPE SNW

For More Copper In Wet Locations

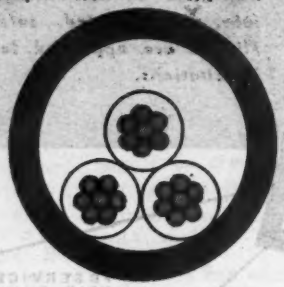


OLD

No. 14/3 Conductor Type RL
Carries 15 amps.

Three No. 10 Type RW
Carry 25 amps.

For ¾" Conduit



NEW

Three No. 6 Type SNW
Carry 54 amps.

Insulated with a special thermoplastic that is extremely resistant to moisture, acids, alkalies and oil, inherently flame-retarding, high dielectric and mechanical strength, bright permanent colors, small diameter, easy pulling, free stripping

SYNTHOL Type SNW

is approved by Underwriters Laboratories in sizes from #14 through #4/0 AWG under section 3035 of the 1940 N.E. Code for use in raceway systems, such as: (a) Underground, (b) In concrete slabs or other masonry in direct contact with the earth, (c) In wet locations, (d) Where the condensation and accumulation of moisture within the raceway is likely to occur.

Write for Descriptive Folder on SYNTHOL Types SNW and SN

CRESCENT INSULATED WIRE & CABLE CO.
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hooks attached. Regardless which of the two it may have been, it meant an added chore and increased production time when baking small items.

The extra labor required to build a rack or set up a means of hanging coils in the oven is entirely eliminated by a built-in overhead suspension carriage—an integral part of a bake oven now on the market. The mechanical design is quite simple, and where over capacities are already adequate, similar arrangements can possibly be built-in to the existing baking facilities of the shop. The oven contains a stationary angle iron frame extending out over the front of the baking chamber. Suspended from this frame by four small wheels, which ride on the angle iron, is a movable carriage equipped with numerous hooks for carrying any small item to be baked. In this way the carriage can be loaded outside the heated area and can be quickly slid into the oven interior with little lost heat involved.

Dipped coils or other items (see accompanying photographs) are placed on these hooks and the carriage pushed into the oven. Once the doors are closed the oven is ready for the bake. Hinged trap-doors cover the openings in the front of the oven for the carriage wheels. When not in use, the carriage is pushed into the oven and stators, rotors, etc., can be placed on perforated metal or screen-type trays which rest on angle iron rails mounted to the sides of the oven interior.

The oven is of the recirculating type with either gas or electric heat and is adjustable for all types of work up to 150 hp. in size. Reports indicate that it cuts baking time 40 percent as compared to the gravity convection type unit.

PRESIDENT of the Electrical Maintenance Engineers of Chicago is J. H. Miller, superintendent of the electrical department, Wisconsin Steel & Works Chicago plant.

BUL. 7332 THERMAL OVERLOAD RELAY
BUL. 4000 PRESSURE REGULATOR
BUL. 6030 X-LINE STARTER
BUL. 7700 AC CONTACTOR
BUL. 6018 X-LINE STARTER
BUL. 6013 X-LINE STARTER
BUL. 100 TYPE RN PUSH BUTTON
BUL. 7315 ELECTRONIC TIME DELAY RELAY
BUL. 7308 RELAY
BUL. 100 DUST TITE PUSH BUTTON
BUL. 100 PUSH BUTTON STATION
BUL. 6002 MANUAL X-LINE STARTER

ALL TYPES OF INDUSTRY

with electric motor drives have use for "3C" Electrical Control Apparatus

Pictured above are a few of the many products, engineered by The Clark Controller Company to do specific jobs in applications on fractional and larger HP motors. These are "packaged" units, complete in themselves . . . ready for wiring, to provide successful operation and protection of AC and DC motors, or to control some machine functions.

Our District Offices and Distributors will welcome your inquiries.

THE CLARK CONTROLLER CO.

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MODERN LIGHTING

HIGH LEVEL LIGHTING FOR CLEANING CYLINDER HEADS

One of the first steps following the casting of the aluminum cylinder heads for the B-29 super-bomber engines is removing the rough edges of the casting. This is done just before the heads are sent to the machining and assembly building to be finished.

At the Dodge-Chicago Plant, Division of Chrysler Corp., this work is done on long rows of benches, each row being approximately 90 feet in length. Employees work on both sides of the bench. Since each cylinder head is surrounded by a maze of thin cooling fins, the cleaning job assumes the aspect of a critical seeing task. A slip of the high-speed, air driven grinding tools—just large enough to manipulate between the fins—might mean damaging the head sufficiently to render it useless. Good quality, high-level, lighting is a very definite "must" in this department.

LINES OF LIGHT border each edge of this workbench where B-29 engine cylinder head castings have their rough spots removed. An even blanket of 100 foot-candles of cool fluorescent lighting is provided on the working plane.

SWIVEL JIGS on a ball and socket type of vise permit workmen to keep cylinder head fins always in a vertical position so light can penetrate the depressions and reveal the rough spots. High-speed, air-driven grinding tools are used on this operation.

High intensity illumination is provided by two continuous rows of fluorescent units running parallel to the benches—23, four-foot, two-lamp, industrial fixtures per row. The units are mounted 6-ft., 3-in. above the floor and so positioned that the inside edge of the fixture coincides with and is directly above the outside edge of the bench. The double row of two-lamp fixtures (two, 40-watt, 3500 degree white lamps) bathes the top of each bench (30-inches above the floor) with an evenly distributed blanket of 100 foot-candles of cool illumination.

To facilitate handling and provide the light where it is needed, the cylinder heads are fastened to a jig mounted on a ball and socket type vise. Thus, the employee can shift the cylinder head so the cooling fins will always be in a vertical position and the light will shine down between them and reveal the rough spots of the casting. This arrangement, with the aid of the high-level, high-quality illumination secured from the lighting, has definitely speeded up this phase of the engine building process.

EFFECT OF FLUORESCENT ON COLORS AND THE SKIN

Would you be able to give a customer a reasonably correct answer if he were to ask what color of fluorescent lighting he should use for a specific application? Undoubtedly there will be an avalanche of such queries in the postwar era—particularly in the commercial and residential field—when non-users of fluorescent express a desire to try it out.

The color factor is extremely important in lighting applications in public buildings where specific decorating schemes are employed and where the general public will assemble. Contractors, engineers and architects must be aware of the effect of fluorescent light on colors and the human skin when making recommendations for this type of lighting. A discussion in the Westinghouse Lighting Handbook covers the highlights of the subject and presents the two charts accompanying this item.

There seems to be no advantage in the color of one light source over that of another from the standpoint of per-

it's easy to see when it's "Day-Brite"
Here's the ...
BLUEPRINT OF YOUR FUTURE
The "dim and distant future" isn't so far away, and—it's easy to see when it's Day-Brite...Much of your business in times ahead is already on blueprints—approved by owners and filed in the offices of architects and engineers—waiting only for the go-ahead signal...Then as now, wherever light is specified, quality is your best business partner. It's the word to remember when you think of Day-Brite and your plans for the future.
The PARKWAY (pictured above)
An open-type unit with die-formed ends finished in baked lustre aluminum enamel. Lamps removable without disturbing ends. Surface or suspension mounting. Get Bulletin F-80.
Consult your nearest Day-Brite Engineering Representative
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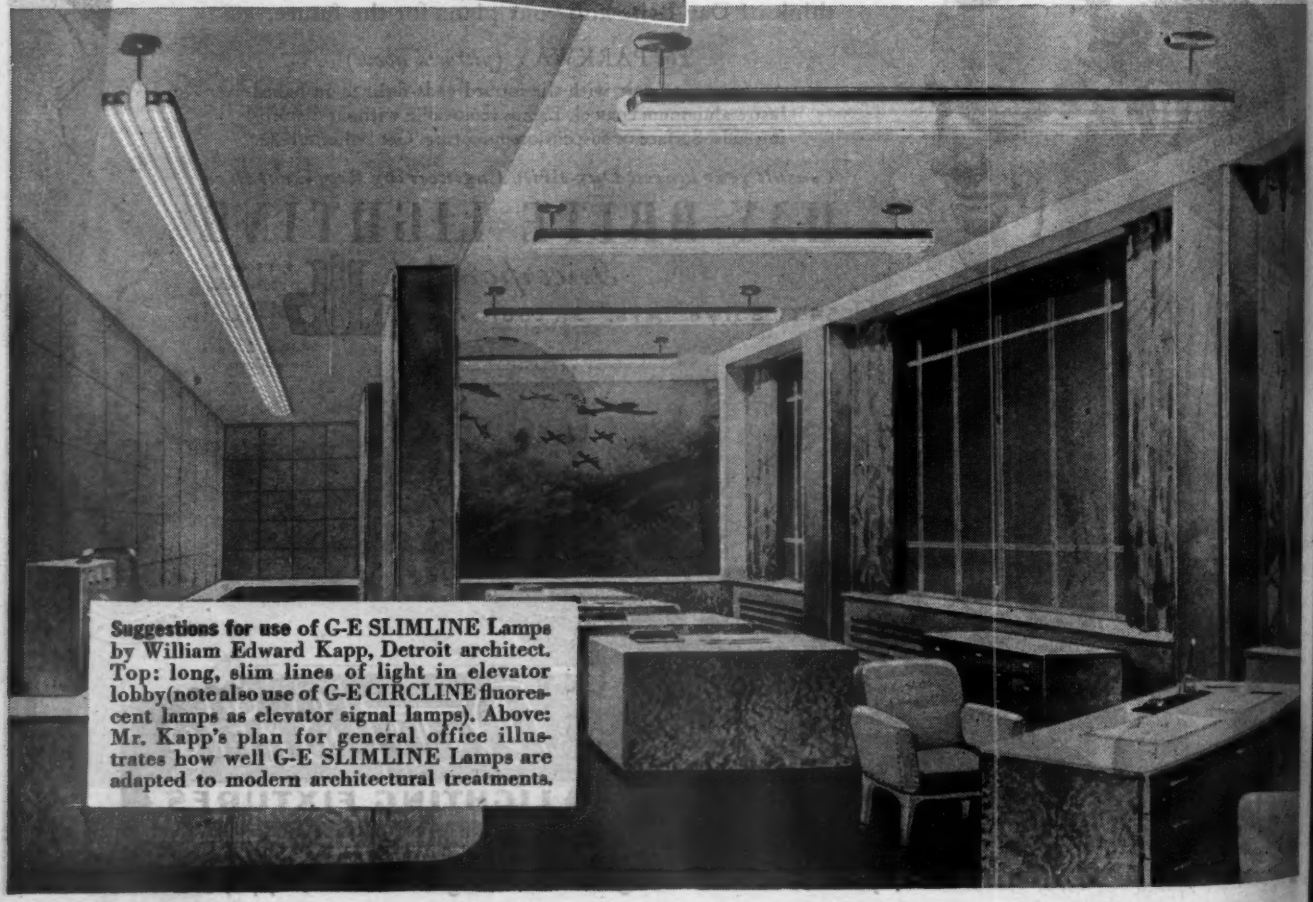
MEMBER
Day Brite
LIGHTING FIXTURES
87
• Nationally distributed through all leading electrical supply houses

TWO NEW NAMES

1 G-E SLIMLINE fluorescent lamps

Several months ago, General Electric announced the G-E SLIMLINE—four new fluorescent lamps with unique new design and operating advantages. These slimmer fluorescent lamps, up to eight feet in length, promise a wealth of new lighting opportunities, especially in the commercial field.

G-E SLIMLINE lamps will be available in two diameters: three-quarters of an inch (42″ and 64″ long) and one inch (72″ and 96″ long). Other outstanding features: (1) instant starting, (2) long life, (3) higher efficiency—average of 60 lumens per watt, (4) operation singly, in multiple or in series and (5) operation over a range of current values from 100 to 200 milliamperes. Quantity production of G-E SLIMLINE Mazda Fluorescent Lamps will proceed as soon as conditions permit.



Suggestions for use of G-E SLIMLINE Lamps by William Edward Kapp, Detroit architect. Top: long, slim lines of light in elevator lobby (note also use of G-E CIRCLINE fluorescent lamps as elevator signal lamps). Above: Mr. Kapp's plan for general office illustrates how well G-E SLIMLINE Lamps are adapted to modern architectural treatments.

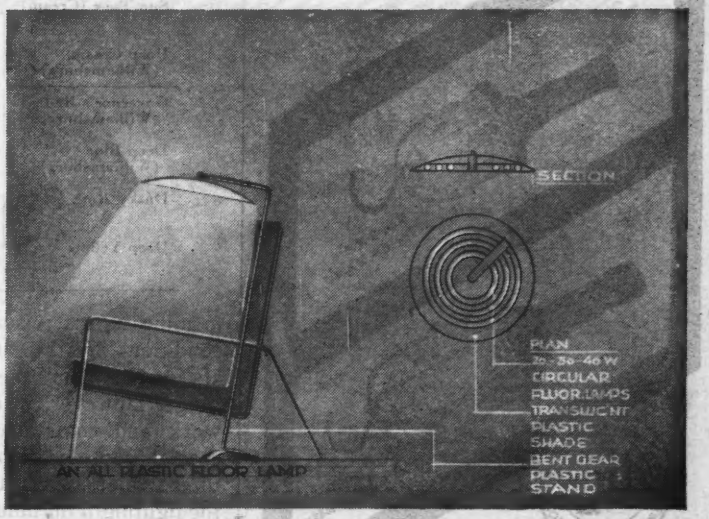
TO REMEMBER:

2 G-E CIRCLINE fluorescent lamps

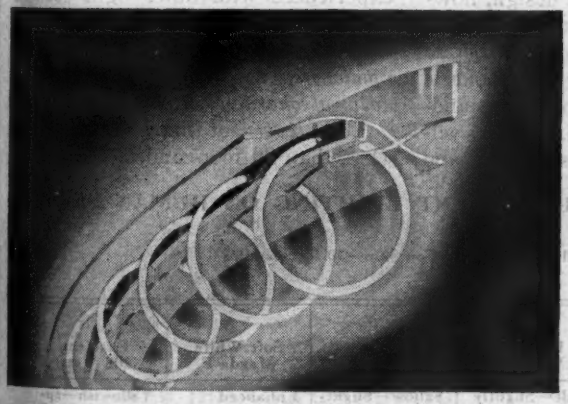
Architects commissioned by G-E to suggest creative ideas for postwar lighting, have been quick to take advantage of the dramatic new design opportunities afforded by G-E CIRCLINE Fluorescent Lamps. Examples are the illustrations on this page.

Present plans call for three circular lamps with approximate outside diameters of 8½, 12¼ and 16 inches. Bulb diameters are expected to range up to 1¼ or 1½ inches, and approximate watts from 15 to 50.

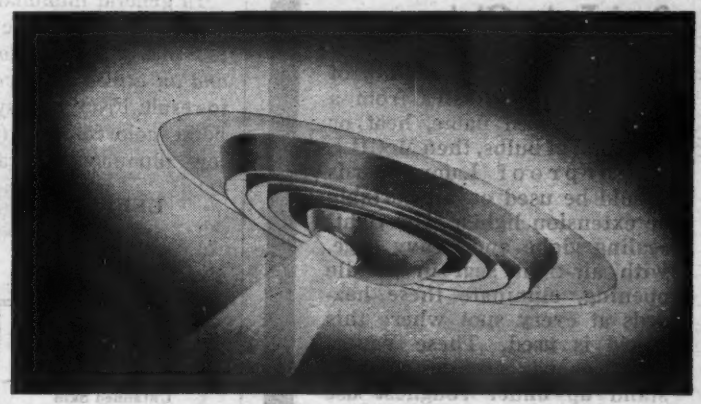
In addition to their use in commercial lighting applications, circular fluorescent lamps probably will find a place in portable and ceiling lamps for the home, either alone or in combination with filament lamps. Final design and production of G-E CIRCLINE Fluorescent Lamps will proceed when conditions permit.



Nest of three G-E CIRCLINE Fluorescent Lamps is used in this floor lamp. Shallow plastic shade gives maximum light. Design suggested by N. A. Owings, of Skidmore, Owings and Merrill, architects, Chicago



Wurdeman & Becket, architects, Los Angeles, envision use of G-E CIRCLINE Lamps in this fixture for stores. Rings of light at regularly spaced intervals in ceilings are designed to direct customer traffic to rear of store. The cast phenolic reflector suggested here would help direct light down on the aisle.



Another Wurdeman & Becket design for a ceiling luminaire for stores, combining G-E CIRCLINE Lamp with filament lamps and spotlamp. At center is R-40 spotlight for dramatic highlighting of merchandise. Above it, a G-E CIRCLINE lamp illuminates bowl. Two 100-watt filament lamps, one on each side of center bowl, furnish general illumination.

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These guards also protect the light bulb and prevent breakage when used around machines where water and oil might splash on the bulb. Guards also are grounded—an additional safety feature.

ASK FOR LITERATURE

McGILL MANUFACTURING CO., INC.
Electrical Division
Valparaiso, Indiana

EFFECT OF FLUORESCENT LIGHTING ON WALL COLORS

Colors of Paints Tested	Daylight Mazda F	White Mazda F	Soft White Mazda F	Filament (100 Watt)
Cascade Blue (Pastel) (Bluish-Green)	Bluish green (preferred)	Greyish green	Slightly greyish	Yellowish faded blue
Palmetto Green (Pastel) (Yellowish Green)	Fresh blue green (preferred)	Yellowish grey	Slightly greyish	Yellowish pale green
Peach (Pastel)	Good—slightly pink	Normal—slightly cold	Normal—slightly pinkish	Normal—same as white
Blossom Pink (Pale)	Purplish pink	Yellowish	Intensified normal pink	Yellowish
Maize Tan (Pastel)	Greyish—cold	Yellowish	Cream—good	Strongly yellow
Sun Tone (Cream)	Faded grey	Slightly greenish	Cream—good	Cream—good
Deep Cream (Williamsburg)	Bluish—excellent	Intensified—good	Slightly greyed —good	Yellowish—fair
Governor's Red (Williamsburg)	Slightly bluish —good	Yellowish—good	Warmer—good	Yellowish—good
Deep Blue (Williamsburg)	Vivid—good	Richer—good	Vivid blue—preferred	Greyed
Dusky Rose	Bluish	Yellowish	Vivid—preferred	Yellowish
Deep Yellow	Greyish-unattractive	Vivid	Slightly grey—good	Reddish

forming normal visual tasks—if other conditions are the same and levels are at least within the average seeing range. However, in certain inspection work and color matching processes, special consideration must be given to the color (spectral distribution) of the lighting if optimum visual efficiency is to be maintained. Experimentation is undoubtedly the safest solution to such design problems.

In general illumination design, however, color cannot be entirely ignored if a pleasing *psychological atmosphere and an attractive decorative scheme* is to result. From the psychological standpoint, colored light (red, orange, yellow illumination) can stimulate and excite; or it can soothe and depress (blue, green, or purple illumination). Pigment colors of walls, draperies and furnishings may vary widely in apparent hue and saturation depending upon the spectral character of the lighting.

The fluorescent lamp with its various "white" colors has done two specific things—presented many new color problems in lighting; and made possible a choice in "colors" never before experienced with other light sources. In selecting the proper "white," consideration should be given to *relative efficiencies* as well as their different *spectral characteristics.*

Low levels of fluorescent lighting (less than 20 foot-candles), regardless

EFFECT OF FLUORESCENT LIGHTING ON HUMAN SKIN

Illumination Level on Skin—50 foot-candles

Description	Daylight Mazda F	White Mazda F	Soft White Mazda F	Filament (100 Watt)
Untanned Skin	Pale—Slightly Grey	Sallow—Slightly greenish for older skins	Enhanced	Yellowish—appearance of slight tan
Observer's Rating	Fair	Acceptable	Preferred	Good
Tanned Skin (Medium)	Greyish Tint	Intensified greenish tint—very sallow	Healthy Glow	Intensified reddish tint
Observer's Rating	Fair	Fair	Preferred	Fair
Deep Pigmentation	Intensified greyish tint	Intensified greenish tint—very sallow	Healthy Glow	Deep rich brown
Observer's Rating	Poor	Fair	Good	Preferred
Sunburned Skin (Red)	Slightly reddish-purple tint	Tanned appearance	Slightly reddish	Fiery Red
Observer's Rating	Fair	Preferred	Good	Poor
Untanned skin—light makeup	Over-emphasized make up in contrast to skin	Makeup greyed—sallow appearance	Blended skin and makeup—improved appearance	Intensified makeup—slightly sallow appearance
Observer's Rating	Poor	Fair	Preferred	Good
Untanned skin—heavy makeup	Further over-emphasis of makeup—very pale skin	Sallow appearance of unpainted skin intensified	Enhanced skin and makeup	Slightly sallow
Observer's Rating	Poor	Fair	Preferred	Good

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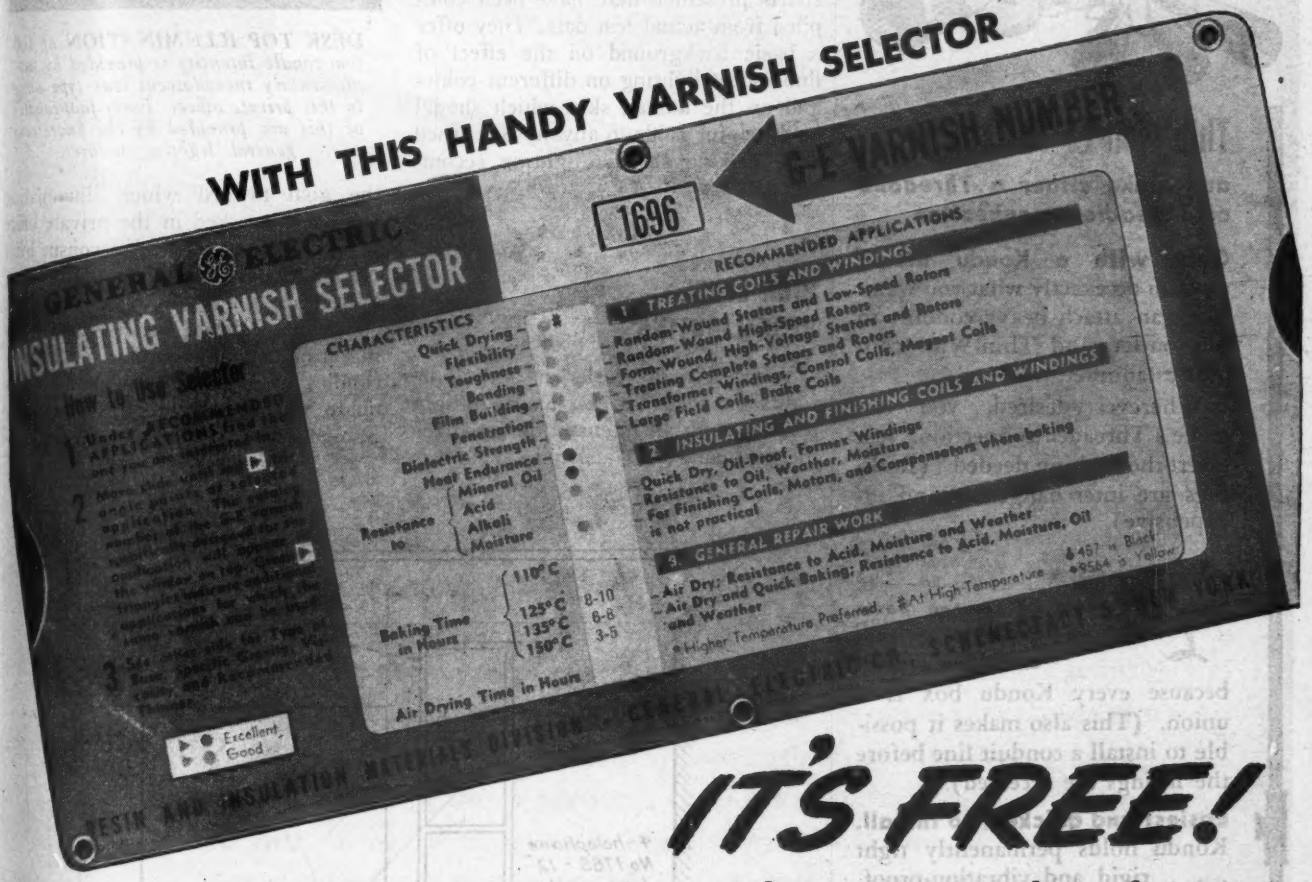
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How to Use Selector
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1696
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Quick Drying
Flexibility
Toughness
Bonding
Film Building
Penetration
Dielectric Strength
Heat Endurance
Resistance to: Mineral Oil, Acid, Alkali, Moisture
Baking Time in Hours: 110°C, 125°C 8-10, 135°C 6-8, 150°C 3-5
Air Drying Time in Hours
RECOMMENDED APPLICATIONS
1. TREATING COILS AND WINDINGS
- Random-Wound Stators and Low-Speed Rotors
- Random-Wound, High-Speed Rotors
- Form-Wound, High-Voltage Stators and Rotors
- Treating Complete Stators and Rotors
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- Large Field Coils, Brake Coils
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Resistance to Oil, Weather, Moisture
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- Air Dry and Quick Baking; Resistance to Acid, Moisture, Oil and Weather
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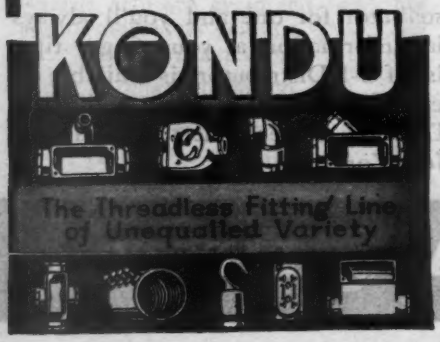


of the "white" chosen, give a psychological impression of coldness and dreariness as compared to an equal level of filament lighting—although the effect on visual acuity in either case is the same provided other seeing conditions are equal. Since the spectrum of all the "white" fluorescent lamps is rich in blue, yellow and green, all colored objects containing pigments of these same colors will have these colors accentuated or over-emphasized compared to their appearance under filament lighting.

If there is any doubt of the final results, *tests* using the various colors of white light on all colored objects under consideration should be made. The charts presented here have been compiled from actual test data. They offer a basic background on the effect of fluorescent lighting on different colors and on the human skin which should be a helpful guide to anyone concerned with making specific lighting recommendations.

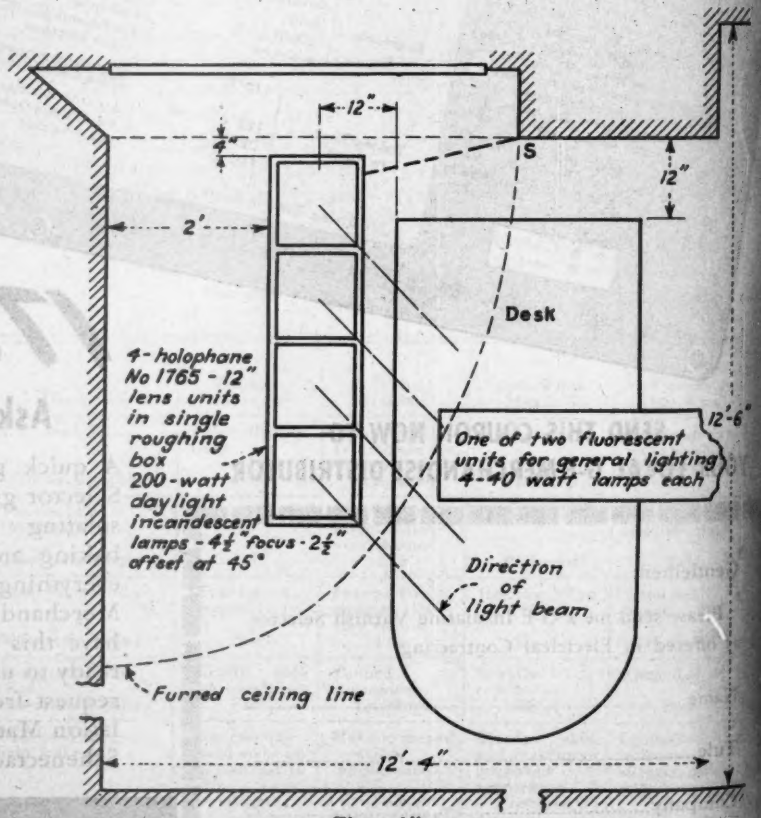
HIGH LEVEL DESK LIGHTING

When a man works at a desk he wants and needs the best quality of light possible with an intensity designed for the particular task at hand. This was the goal toward which illuminating engineers worked in the private office of E. J. Kraus in the Wisconsin First National Bank Building, Milwaukee, Wisconsin.

***DESK TOP ILLUMINATION** of 100 foot-candle intensity is provided by supplementary incandescent lens type units in this private office. Forty foot-candles of this are provided by the fluorescent general lighting fixtures.*

Former indirect incandescent lighting provided a maximum of 15 foot-candles of illumination—totally inadequate for any degree of close work. Subsequently two direct-indirect, low-

[Continued on page 178]


12"
4"
12"
2'
Desk
4-holophane No 1765 - 12" lens units in single roughing box 200-watt daylight incandescent lamps - 4½" focus - 2½" offset at 45°
12'-6"
One of two fluorescent units for general lighting 4-40 watt lamps each
Direction of light beam
Furred ceiling line
12'-4"
Plan View

***SUPPLEMENTARY LIGHTING** is installed flush in a furred area directly directly behind the edge of the desk (note dimensions in above plan view). Controlled beams of daylight at (45 degrees to the length of the desk) provide 60 foot-candles of additional illumination where needed most. (Figure 1)*

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WRITE TODAY FOR NEW BULLETINS containing complete descriptions and data on the various Benjamin RLM Fluorescent Units now available. These include Twin and Triple Lamp closed and open-end units for both 48" and 60" fluorescent lamps; also, the Benjamin dust-tight and vapor-tight fluorescent units and the Type "V" non-metallic reflector Fluorescents. Write Product Information Department H Benjamin Electric Mfg. Co., Des Plaines, Illinois.

**Subject to existing priority regulations.*

***Experience has proven that there is no substitute for the strength, durability, high light output, diffusion and sustained lighting efficiency of porcelain enamel. It cannot decompose, oxidize or disintegrate. It is impervious to practically all atmospheric conditions obtaining in Industry. Its glass-hard surface cannot be penetrated by dirt nor grime nor worn away by repeated washings. It is the easiest of all reflecting surfaces to clean . . . soap and water quickly restoring it to its original light reflecting efficiency.*

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Selection and Application of Synchronous Motors—III

Good efficiency and power factor can be obtained with the low speed direct-connected synchronous motor for many industrial drive applications.

By A. P. Burris,
New York District Manager
Electric Machinery Manufacturing Co.

IN the high speed motor ratings, the problem of selection between a synchronous type and an induction type may not always be clear cut. Engineers may differ in some cases as to which should be installed on a given application. For driven machines which run at a constant, low speed, however, there is much less possibility of a difference of opinion. For a drive application which operates at 450 rpm. or less, a direct-connected synchronous motor is almost always selected where the horsepower is one hundred or more. This is a logical result of the factors favoring this type of installation.

The operating power factor of an induction motor drops off badly at the lower speed ratings. With this goes a marked decrease in efficiency. The result is an excess in kilowatt hours consumed, and a poor plant power factor, both of which contribute to a high cost of power. Consequently, the squirrel cage motor is seldom recommended for direct connection to the load on the lower speed applications; and, generally, the direct-connected synchronous motor is the type preferred. Therefore, if an engineering comparison is to be made, it is generally on the smaller horsepower ratings and between the low speed synchronous machine, and the high speed motor, either induction or synchronous, connected to the load through belts, gears, or other power transmission devices.

The direct-connected synchronous motor has several advantages. The resulting installation is generally more efficient, when losses in the belts or gears are considered. Elimination of the belt, chain or gear drive results in a smaller requirement for floor space. Maintenance and renewal cost of the power transmission system is also eliminated. These three points, plus the inherent advantage of a synchronous machine's operating power factor tip the scales definitely in favor of the direct-connected low speed synchronous motor. On the larger horsepower ratings, say 150 and up, these advantages become even more pronounced and competition from high speed motors is eliminated in most cases. However, there is the qualification in which the speed of the driven machine is probably the major factor. In very low speed jobs the direct-connected motor cost may increase to the point where the economics dictate a comparison with a high speed motor and power transmitting drive.

The normal starting and pull-in

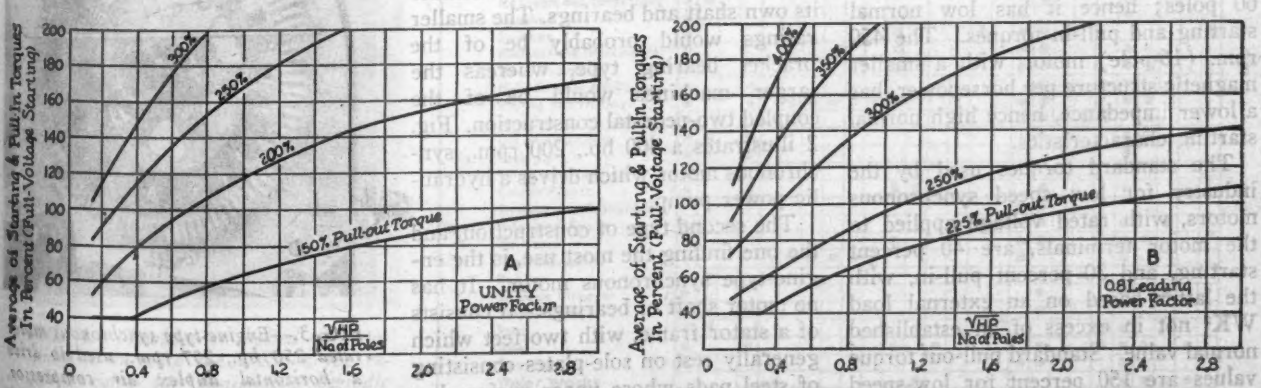


FIG. 1.—Empirical curves showing the relationship between starting and pull-in torque, pull-out torque, and horsepower and speed.

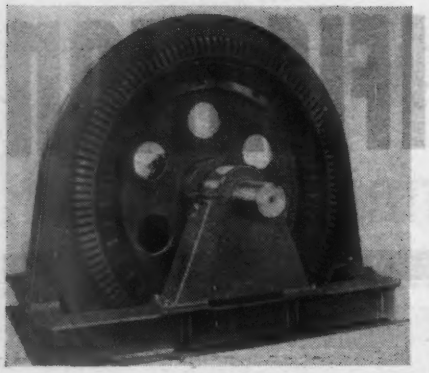


FIG. 2—Coupled-type synchronous motor rated 400 horsepower, 200 rpm., used to drive an hydraulic power pump. Two-pedestal type bearing construction supports rotor and shaft.

torque available from the synchronous motor depends on the horsepower and speed, and also on the pull-out torque and power factor rating of the motor. How these factors affect the average of starting and pull-in torques is shown by the empirical curves of Fig. 1. These curves show approximate empirical relationship of starting and pull-in torque, to pull-out torque, for unity power factor (A) and 80 percent leading power factor (B) 60 cycle low speed synchronous motors. For example, from the curve for unity power factor and 150 percent pull-out torque, a 400 hp., 120 rpm., (60-pole) motor having a "square-root of the horsepower divided by the number of poles" ($\sqrt{HP} \div$ No. of Poles) factor of 0.33, has a normal average of starting and pull-in torque less than 40 percent, while a 400 hp., 450 rpm., (16 pole) motor, having a $\left(\frac{\sqrt{HP}}{\text{No. of Poles}}\right)$ factor of 1.25, has an average of about 70 percent. Thus it is seen that the starting torque characteristics of the synchronous machine depend to a large extent on the speed rating of the motor.

The 120 rpm motor inherently has a high impedance because of its comparatively large magnetic structure per horsepower, necessary because of its 60 poles; hence it has low normal starting and pull-in torques. The 450 rpm. (16-pole) motor, with a smaller magnetic structure per horsepower, has a lower impedance, hence high normal starting characteristics.

The standard torques used by the industry for low speed synchronous motors, with rated voltage applied to the motor terminals, are 40 percent starting, and 30 percent pull-in, with the latter based on an external load WK^2 not in excess of an established normal value. Standard pull-out torque values are 150 percent for low-speed unity power factor motors, and 200 percent for the 0.8 p.f. motor, both based on normal excitation as well as normal line voltage.

Low-Speed Classifications

The low speed synchronous motor classification is divided into two groups. The first is for those driven machines which can be kept unloaded throughout the period of motor starting and synchronizing. In such cases the motor torques need be only sufficient to accelerate the load of windage, friction, and inertia of the moving parts of the motor and driven machine. Normal motor torques are generally sufficient. Reciprocating-type air, gas, or ammonia compressors, for example, that are completely unloaded during starting, are examples of this type of application.

The second group covers those machines which must be started up under load, and consequently require higher starting and pull-in torques. Ball and tube mills for grinding rock products and ore, banbury mixers and mill lines in rubber mills, flour mill lineshafts, and beaters or chippers in paper mills are examples of low speed synchronous motor applications where appreciably higher-than-normal torques are necessary. Synchronous motors, used for such applications, have been both widespread and successful.

These two general divisions as to torque were illustrated by Fig. 4 of the December, 1944, article. The approximate motor torque curve, together with motor current inrush is shown for a compressor drive, illustrating the low, or normal motor torque group. Similar curves for a synchronous motor driving a ball mill illustrate the second group, where higher than normal torques are necessary.

Mechanical Construction

Two types of motor mechanical construction comprise the big majority of low speed synchronous motors. One is the coupled type, which includes its own shaft and bearings. The smaller ratings would probably be of the bracket bearing type, whereas the larger machines would be of the coupled two-pedestal construction. Fig. 2 illustrates a 400 hp., 200 rpm., synchronous motor which drives a hydraulic power pump.

The second type of construction, and the one finding the most use, is the engine-type synchronous motor. It has no motor shaft or bearings. It consists of a stator frame, with two feet which generally rest on sole-plates consisting of steel pads whose upper surface has been machined to give a true support for the motor feet. The rotor has its center hub bored to accurately fit the shaft of the driven machine, to which it is keyed for rigidity. With this type of motor application, the need for a motor shaft as well as a coupling between the shaft and the driven machine is eliminated. A material reduction in first cost and required floor space results.

Fig. 3 is an engine type synchronous motor rated 250 hp., at 257 rpm., and drives a horizontal duplex air compressor. Its component parts, identified by the numbers, are:

1. Stator frame
2. Stator coils
3. Coil guard
4. Spider
5. Split rotor
6. Shrink links
7. Field poles
8. Starting, or squirrel cage winding
9. Collector rings
10. Brush holders and brushes
11. Soleplate
12. Armature terminals

Compressor Application

Reciprocating compressors, for ammonia, air and gas, use many more synchronous motors than any other application.

For most such installations, the engine-type motor is used. On a two cylinder vertical compressor, the rotor may have a split hub, and be supported by the extension from the compressor crank shaft, overhung on the smaller ratings, and additionally supported by an outboard bearing on the larger. On a duplex compressor, where the driving motor is mounted in between the compressor cylinders, the motor is furnished with a split rotor, as illustrated in Fig. 3, so that it can be mounted on

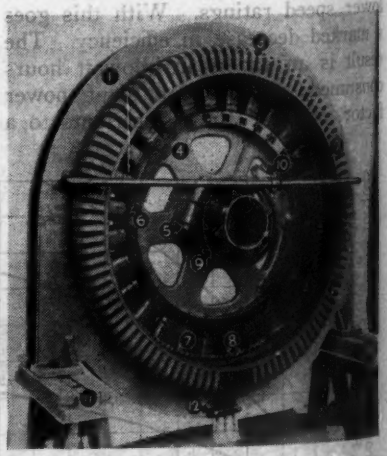


FIG. 3.—Engine-type synchronous motor rated 250 hp., 257 rpm., used to drive a horizontal duplex air compressor. Numbers identify component parts.

the crank shaft. This type of compressor shaft would have a crank disc on either end.

Sometimes two two-cylinder vertical compressors are arranged as a twin installation with the rotor of the motor secured to both compressor shaft extensions. The motor is then furnished with a split hub, longer than normal. Each compressor shaft extension enters part way into the hub which acts as a coupling between them. Such an installation, to give flexibility, may require operation of one compressor only at times. Longer than normal soleplates are then furnished, permitting the complete motor to be slid over so that it drives one unit only.

In general, normal low speed motor torques are sufficient for reciprocating compressors, the cylinders being bypassed or unloaded so that there is little more than the friction load and inertia of moving parts to be handled. One exception is on booster compressors. A compressor which in regular service would require 300 horsepower with normal suction and discharge pressures might need only a motor rated 100 hp. or less when used as a booster because of the low pressure differential between the suction and discharge. Obviously it would require the same actual torque to start it regardless of the service, and this would be a proportionately higher percentage when applied to the smaller horsepower rating.

Flywheel Effect

Reciprocating compressors require a pulsating torque due to the varying crank effect. Since a synchronous motor inherently operates at a constant speed, and varies its torque by slight changes in angular displacement, a periodic variation in power input results. It is necessary to adjust the flywheel effect so that the forced frequency of the compressor is different than the natural frequency of the motor. The proper flywheel effect is necessary to prevent the mechanical oscillations due to the load, and those due to the varying motor torque, from combining in a manner to cause resonance. At the same time it will limit the extent of the current variation.

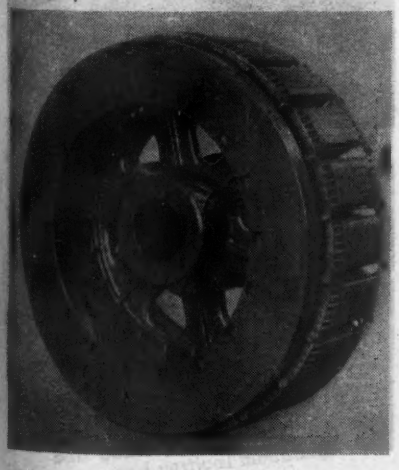


FIG. 4.—Flywheel is bolted to rotor spider to increase the WK^2 to the required value for minimizing periodic load fluctuations.

The maximum allowable limit generally accepted, is a variation in the motor armature current which does not exceed 66 percent of the full load current rating of the machine.

This limit is set more by the effect on the power supply rather than the effect on the motor which could stand a greater current variation without any appreciable effect on its performance. On power lines where lighting supply is also involved, a minimum of current variation is necessary to prevent light flicker.

The compressor manufacturer, in furnishing the motor along with his compressor, accepts the responsibility for furnishing proper flywheel effect (WK^2) to comply with the existing requirements.

Often extra flywheel effect is necessary, over that included in the normal motor. With air compressors, the general practice has been to include a separate flywheel, furnished by the compressor builder. Ammonia compressor manufacturers, on the other hand, have preferred to have this extra WK^2 built into the rotor of the motor. Both methods are used by manufacturers of both types of compressors,

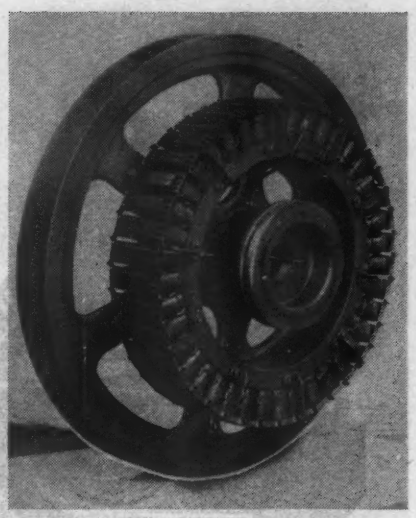
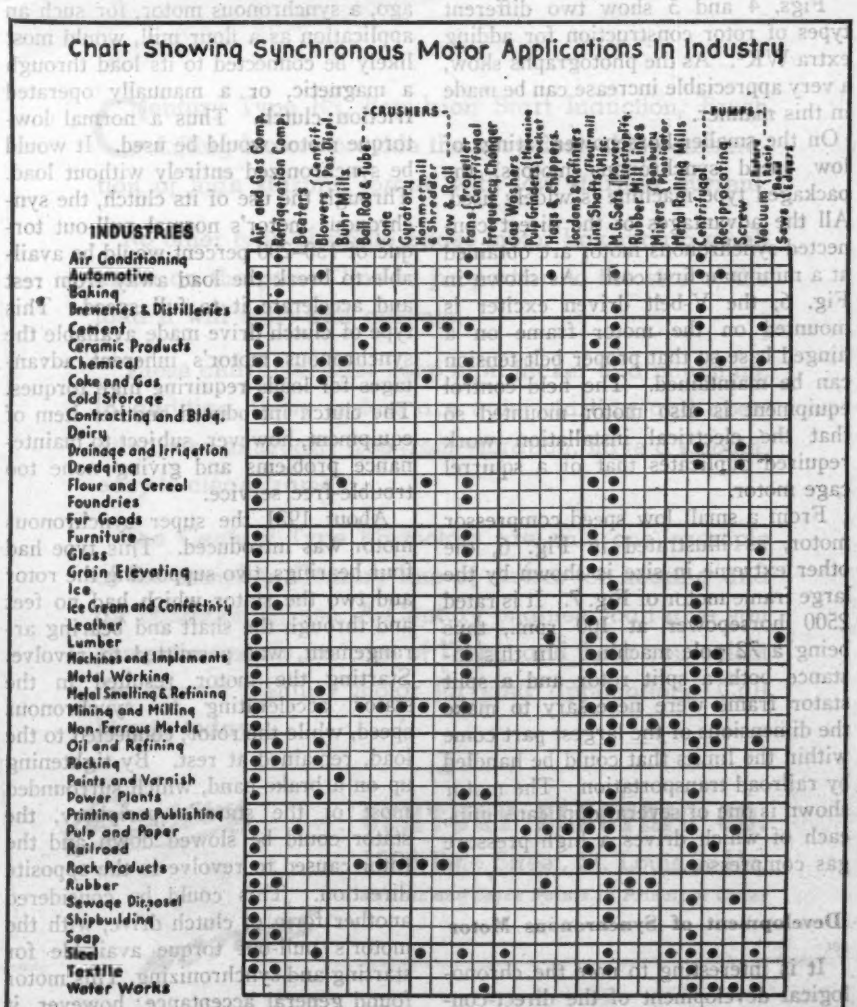


FIG. 5.—Where flywheel effect is required in greater amounts, rotating field frame is bolted to flywheel spider.



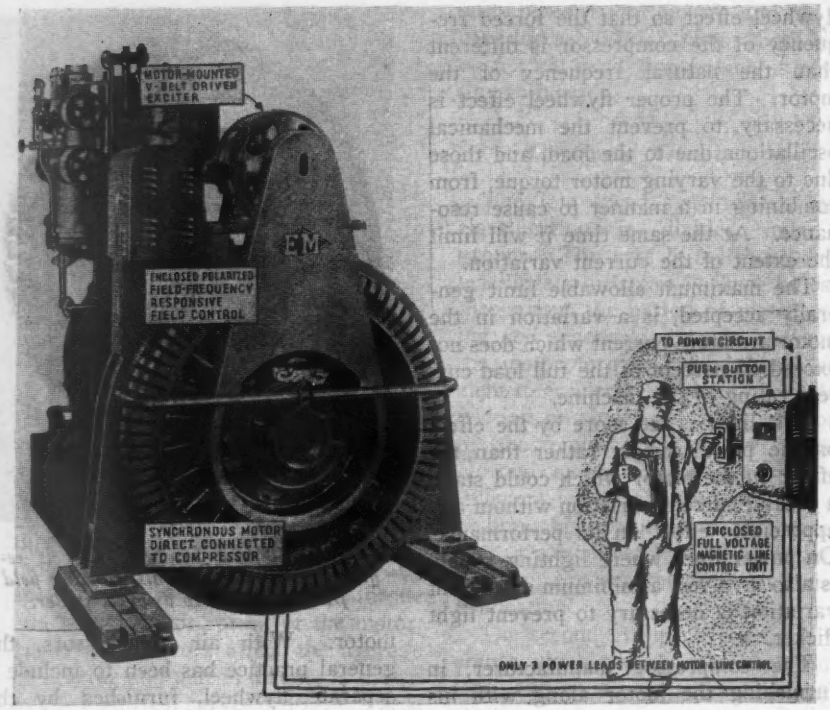

MOTOR-MOUNTED V-BELT DRIVEN EXCITER
ENCLOSED POLARIZED FIELD-FREQUENCY RESPONSIVE FIELD CONTROL
SYNCHRONOUS MOTOR DIRECT CONNECTED TO COMPRESSOR
TO POWER CIRCUIT
PUSH-BUTTON STATION
ENCLOSED FULL VOLTAGE MAGNETIC LINE CONTROL UNIT
ONLY 3 POWER LEADS BETWEEN MOTOR & LINE CONTROL

FIG. 6—Self-contained low speed synchronous motor with the V-belt driven exciter mounted on the motor frame. Automatic field control is also mounted on frame.

depending on the circumstances of the specific case.

Figs. 4 and 5 show two different types of rotor construction for adding extra WK^2. As the photographs show, a very appreciable increase can be made in this manner.

On the smaller horsepower ratings of low speed synchronous motors, the packaged type machine is widely used. All the advantages of the direct connected synchronous motor are obtained at a minimum first cost. As shown in Fig. 6, the V-belt driven exciter is mounted on the motor frame on a hinged base so that proper belt tension can be maintained. The field control equipment is also motor mounted so that the electrical installation work required duplicates that of a squirrel cage motor.

From a small low speed compressor motor, as illustrated in Fig. 6, the other extreme in size is shown by the large frame motor of Fig. 7. It is rated 2500 horsepower at 100 rpm., thus being a 72 pole machine. In this instance both a split rotor and a split stator frame were necessary to make the dimensions of the largest part come within the limits that could be handled by railroad transportation. The motor shown is one of several duplicate units, each of which drives a high pressure gas compressor.

Development of Synchronous Motor

It is interesting to note the chronological development of the direct-connected high-torque, low speed synchronous motor. Twenty-five years ago, a synchronous motor, for such an application as a flour mill, would most likely be connected to its load through a magnetic, or a manually operated friction clutch. Thus a normal low-torque motor would be used. It would be synchronized entirely without load. Through the use of its clutch, the synchronous motor's normal pull-out torque of 150–200 percent would be available to break the load away from rest and accelerate it to full speed. This type of clutch drive made available the synchronous motor's inherent advantages for loads requiring high torques. The clutch introduced another item of equipment, however, subject to maintenance problems and giving none too trouble-free service.

About 1921 the super synchronous motor was introduced. This type had four bearings, two supporting the rotor and two the stator which had no feet and through the shaft and bearing arrangement, was permitted to revolve. Starting the motor resulted in the stator accelerating to synchronous speed, while the rotor, connected to the load, remained at rest. By tightening up on a brake-band, which surrounded most of the stator's periphery, the stator could be slowed down and the rotor caused to revolve in the opposite direction. This could be considered another form of clutch drive, with the motor's pull-out torque available for starting and synchronizing. This motor found general acceptance; however, it was complicated mechanically and therefore relatively high in first cost, and involved extra maintenance usual to a clutch type motor.

In the early nineteen thirties, the high-torque synchronous motor was offered for direct connection to the load, without any form of clutch being required. This rapidly made the earlier types of drive obsolete. Today, it is the preferred drive, being the most simple, requiring less maintenance, and in general, giving better overall service. The development of the part-winding motor and control (described in the next article) materially aided the development of this type of drive.

Excitation

To supply excitation for the low speed synchronous motors the induction motor-generator set is most widely used. The motor mounted V-belt driven exciter, as shown in Figure 6, has proved to be quite satisfactory and also is generally the lowest in first cost, particularly when installation costs are considered.

Direct-connected exciters, always desirable, are the most expensive, particularly at the lower speeds. In those plants where a direct current bus is maintained, excitation can be most economically obtained from this source.

Protective Covers

As in the high speed group, motor protective covers or enclosures can be obtained to meet the requirements of the particular installation. Fig. 8 illustrates an enclosed, separately-ventilated low speed engine type synchronous motor for compressor drive. The cooling air, circulated by a motor-driven blower, enters through the side

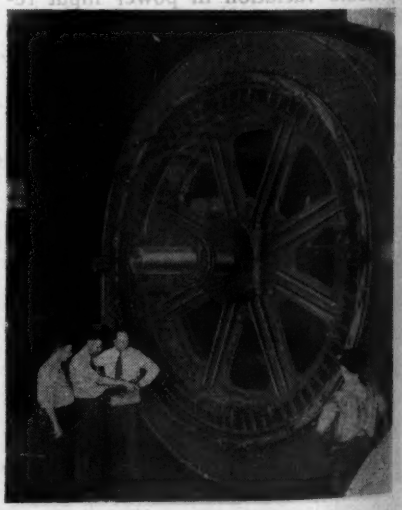


FIG. 7.—This large motor rated 2500 hp., 100 rpm., has a split rotor and stator frame to meet shipping requirements of railroad transportation facilities.

Smooth External Appearance—Type RS, 1½ HP, 1750 RPM, 110/220 volt, 60 cycle, Repulsion Start Induction, single phase, brush lifting motor.

Smooth External Appearance—Type RS motor, ½ HP, 1800 RPM, 110/220 volt, 60 cycle, Repulsion Start Induction, single phase, brush lifting motor. Smooth contour easily cleaned, blends well with the driven equipment.

Cushion Base—Type RS, for 1½, 2, and 3 HP sizes, eliminates the transmission of vibration from the motor to surrounding equipment.

Cover Protects Vital Parts—Vertical ball bearing motor showing cover and vertical mounting.

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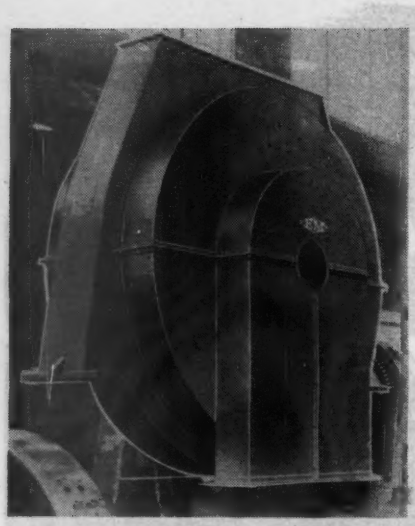


FIG. 8.—Enclosed, separately-ventilated low speed engine type synchronous motor rated 700 hp. at 180 rpm. Cooling air is circulated by a motor-driven blower.

enclosure, and is exhausted through the top of the frame, to the motor room. The enclosure and motor frame construction can be so arranged that the air may be exhausted out through the bottom, or through duct work to the outside air. The purpose is to allow the installation of synchronous motors where explosive gases might be present in the room atmosphere. The blower, driven by a small separate motor, is generally started before the synchronous motor is put into operation. Thus any explosive gases that may have entered the motor enclosure during the period of motor shutdown are forced out. Only the clean non-explosive cooling air is circulated through the motor enclosure. By creating an internal pressure, slightly above atmospheric room pressure, any explosive gases that may be in the room are prevented from entering the enclosure.

Guarantee Tests

The motor manufacturer always makes sufficient tests on each machine to satisfy himself that the motor will operate satisfactorily and meet its guarantees. Such tests are normally included in the price of the standard machine and are referred to as "Minimum Commercial Tests". They include electrical tests to check the resistance of the armature and field windings, the polarity of the field coils, and high potential tests on the coils to assure there are no weak spots in the insulation. In addition, the air gap is checked.

At an extra cost, additional tests will be performed to determine the actual efficiency by the measurement of losses, to establish the temperature rise by a heat run, or to test for the actual motor torques. On critical installations, certified copies of these special tests may be worthwhile to accurately determine the performance of the equipment involved.

In comparing competitive synchronous motor propositions, the quoted efficiences should, of course, always be on the same basis. For example, when an engine-type motor is furnished, the friction and windage losses are not included in the values quoted. The logic behind this is that these two losses, friction and windage, must be measured together and cannot be separated, one from the other. As the friction loss would be in the bearings which are supplied as part of the driven machine, the motor manufacturer cannot guarantee what this loss might be. When the bearings are included as part of the motor equipment, the windage and friction losses are included in the motor guarantee.

Similarly, consideration should be given to the type of excitation equipment used and its effect on the overall or input-output efficiency. The normal motor efficiency, as quoted by all manufacturers, includes the copper or I^2R losses in the motor field. The losses in the exciter are not included however, unless the inquiry so specifies. Belted and direct connected exciters have approximately the same losses, however, induction motor-generator set exciter losses run somewhat higher. Where excitation is taken from a plant d.c. bus, it must be controlled by a rheostat or tapped resistor which losses are not included in the guarantees as made.

Dual Speed Ratings

On drives such as a banbury mixer in a rubber mill, two different speeds may be necessary or desirable. For a two to one speed ratio, the single frame, two speed, pole changing type of motor may be used. This consists of a motor with its coils so wound and connected that it can be operated with either its normal number of poles, or half that many. To accomplish the latter, the field coils of two adjacent field poles are so connected that the two poles in question have the same polarity and consequently act as a single pole. While such a motor has the advantage of requiring a minimum floor space, its design must necessarily be a compromise and the operating characteristics consequently are impaired.

The generally preferred type of two speed synchronous motor has two entirely separate motor structures (see Fig. 9) mounted on a common shaft and set of bearings. One motor revolves idly while the other is driving the load. Each can be designed to give its best operating performance. Any combination of speeds can be obtained, not being limited to the two to one ratio. The only objection is that it requires more floor space than the single frame type.

As was the case with high-speed synchronous motors, low-speed synchronous machines can be designed with the mechanical frame construction necessary for the application. This includes vertical type motors, horizontal single bearing, and special mounting dimensions that might be required to meet existing conditions.

It has been the intent of this and the preceding two articles to give the reader a brief survey of points to be considered in the selection and application of synchronous motors. As indicated in the application chart, synchronous motors do have many applications in a widely varied group of industries. Many of these applications have similar basic motor requirements. It is our hope that these articles may cause prospective users to give sufficient consideration to these fundamentals to assure successful motor performance. First cost is of course important in the purchase of new drive equipment but other factors are often more critical. Careful consideration of power factors, efficiencies and maintenance items in computing operating costs plus the other factors considered herein will generally determine the proper selection.

Only the more ordinary or "every day" type of installation has been considered, as they by far outnumber the very large and very special drives.

As the success of the installation however, depends almost as much on the motor control equipment as on the motor itself, these articles are not complete in themselves. The next article will, therefore, consider the selection and application of synchronous motor control.

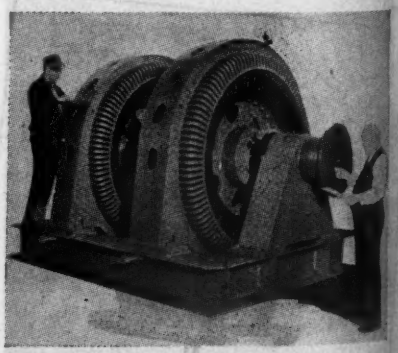
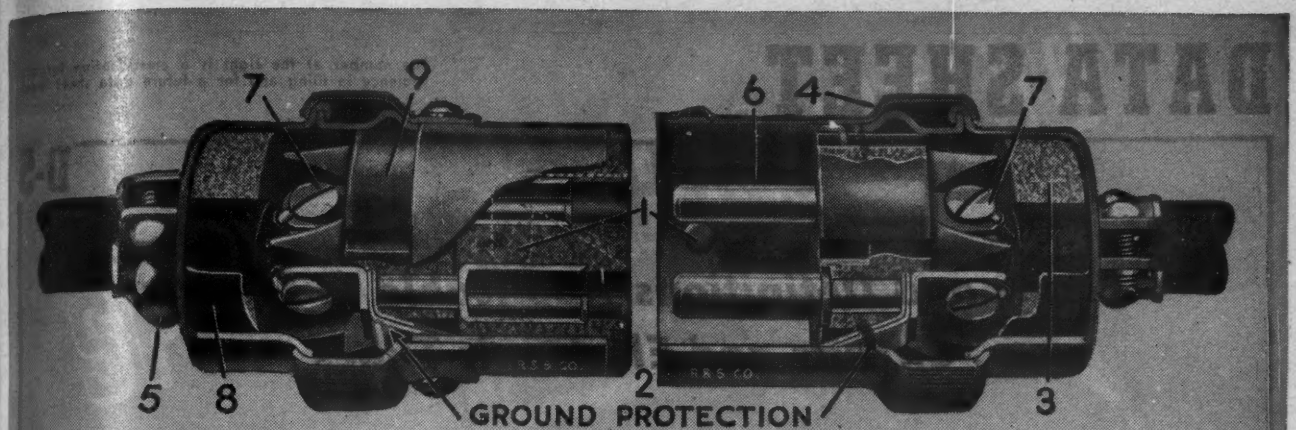


FIG. 9.—Two-speed, high torque type synchronous motor used to drive a banbury mixer and rated 600 hp., 240 rpm., 450 hp., 180 rpm. Two frame, a common shaft and two pedestal-bearings are required.



EVER-LOK

Receptacles, Plugs and Cord Connectors

Ever-Lok is a simple automatic locking connection. It prevents accidental disconnection, is self aligning, well built and available in the form of receptacles and plugs for outlet and conduit boxes, surface and gang types, reverse and multiple circuit, weathertight and for cord connectors and also many special adaptations. The principal features shown above are—

1. Automatic Locking is positive—no chance of faulty contact. A twist of plug shell permits instant unlocking and withdrawal of plug.

2. Positive Grounding provides maximum protection to personnel and equipment.

3. Dust-proof—to exclude metal particles, dust, etc., from interiors of plugs and connectors.

4. Steel-Clad — Provides maximum protection. Light in weight, yet sturdy.

5. Cord Grip — Adjustable for wide range of cable sizes. Prevents strains on connections and protects cable.

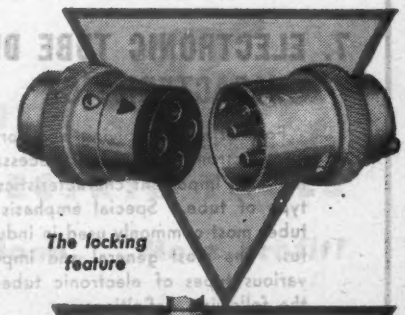
6. Contacts are machined, self-wiping and self-aligning.

7. Unit Assembly—Housing assembly plus interior assembly—easy wiring—only two pieces to handle. No screws to take out and lose.

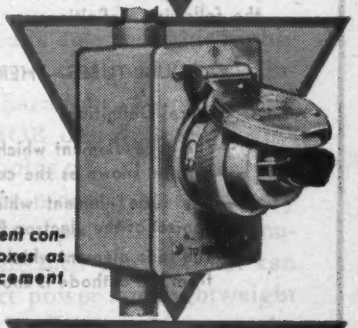
8. Caps fibre-lined to prevent stray wire ends touching the shell.

9. Interiors—molded bakelite.

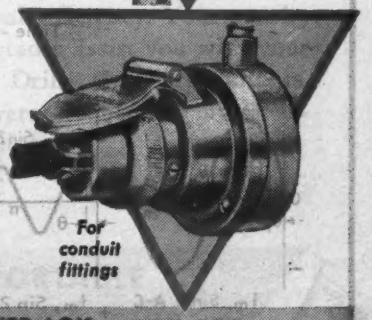
10. Polarized — Plugs cannot be inserted the wrong way.



The locking feature



In present conduit boxes as replacement units.



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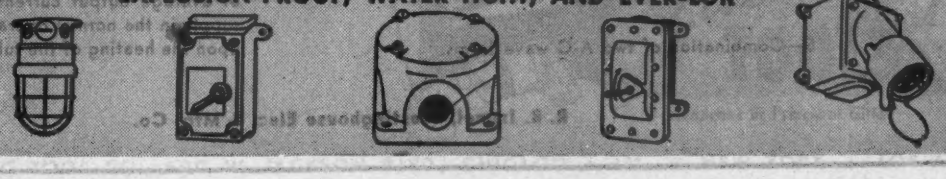

DATA SHEET

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D-5

Terms and Definitions Applicable to Electric Circuits and Electronic Tubes

6. COMBINATION of TWO ALTERNATING CURRENT WAVE FORMS

When two alternating currents are superimposed on the same circuit, the resultant wave is a combination of the two as shown by Fig. 5. It should be noted that the resultant wave form is dependent upon the frequency, magnitude, and phase displacement of each wave. Effective current values can be determined graphically, calculated mathematically, or measured by instruments. It should be noted that the resultant wave form is the algebraic sum of the instantaneous current values of the two waves.

7. ELECTRONIC TUBE DEFINITIONS and CHARACTERISTICS

For correctly applying and for thoroughly understanding electronic tubes, it is necessary to consider some of the most important characteristics and limitations of each type of tube. Special emphasis has been given to the tubes most commonly used in industrial electronic apparatus. The most general and important characteristic for various types of electronic tubes may be expressed by the following definitions:

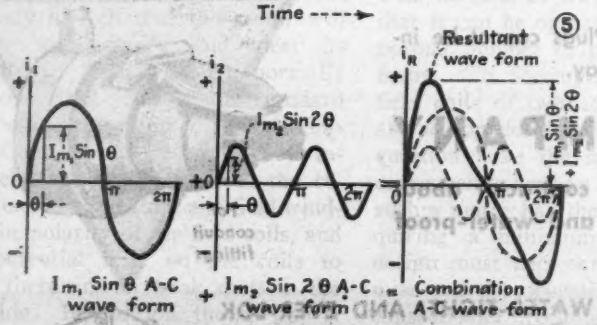
A. VACUUM TUBES—THERMIONIC EMISSION

a. General Definitions

—The tube element which provides the source of electrons is known as the *cathode*.

—The tube element which provides the electrostatic control of the electron flow is known as the *grid*.

—The tube element which collects the electrons emitted from the cathode is known as the *anode or plate*.



5—Combination of two A-C wave forms.

—The tube element which reduces the capacitance between the grid and anode is known as a *screen grid*.

—The tube element which repels and returns secondary electrons to the anode is called the *suppressor grid*.

—The power dissipated in the form of heat by the anode is the result of electron bombardment and is termed *anode dissipation*. It is the difference between the power supplied to the anode of the tube and the power delivered by the tube to the load.

—*Screen dissipation* is the power dissipated in the form of heat by the screen as a result of the electron bombardment.

—*Static Characteristics* of a tube are usually plotted on and shown by a curve to give the anode current which will flow at specific values of grid and anode voltage. These valves are taken experimentally from a circuit which does not have any output device in the anode circuit for transferring the effect of variations in anode current to a load in the external circuit.

—*Dynamic Characteristics* of a tube show the behavior of a tube with an actual load in the anode circuit for specific values of grid and anode voltage. It is indicative of the tube performance under actual operating conditions.

—Any pair of electrodes in a tube form a miniature condenser. The capacities are known as the *grid-to-anode*, *grid-to-cathode*, *anode-to-cathode*, and the *control grid-to-screen capacitance*. This group of capacitances are often referred to as inter-electrode or inter-element capacitances.

b. Vacuum Diode—Kenotron

—The function performed by a two-element tube is that of *rectification*, the translation of alternating currents into unidirectional pulsating currents.

—*Maximum peak inverse anode voltage* is the highest instantaneous peak voltage that a tube can withstand between the cathode and anode in the direction opposite to that in which it is designed to pass current. The actual surge or transient voltages of a particular circuit should be checked by means of a cathode ray oscilloscope. Voltage in excess of this rating will probably cause the tube to arc-back or permit current to flow in the wrong direction.

—*Maximum peak anode current* is the highest instantaneous peak current that a tube can carry recurrently in the direction of normal current flow.

—*Maximum average anode current* is the highest value of average output current that the tube can safely supply in the normal operating direction. It is based upon the heating of the tube and the duty cycle.

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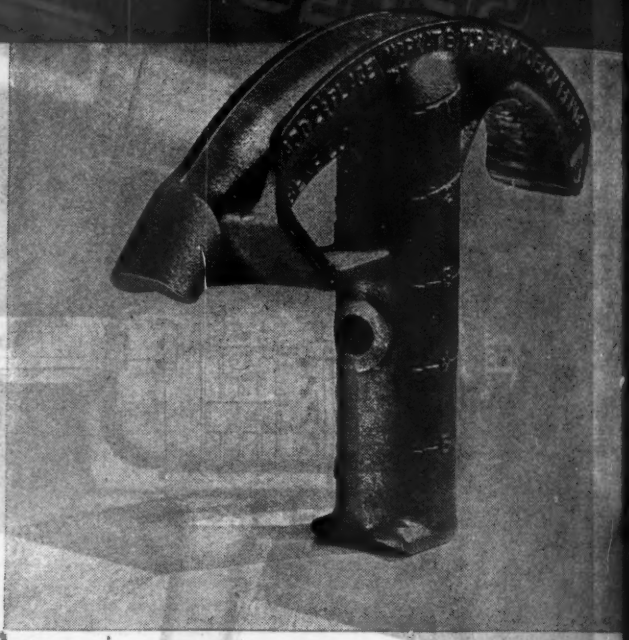
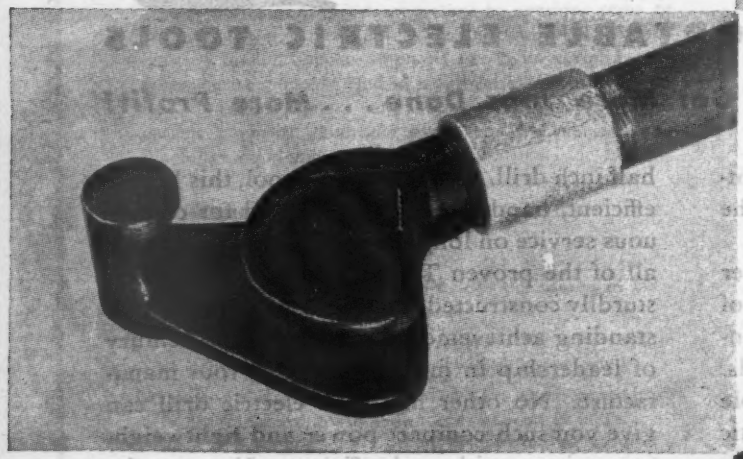


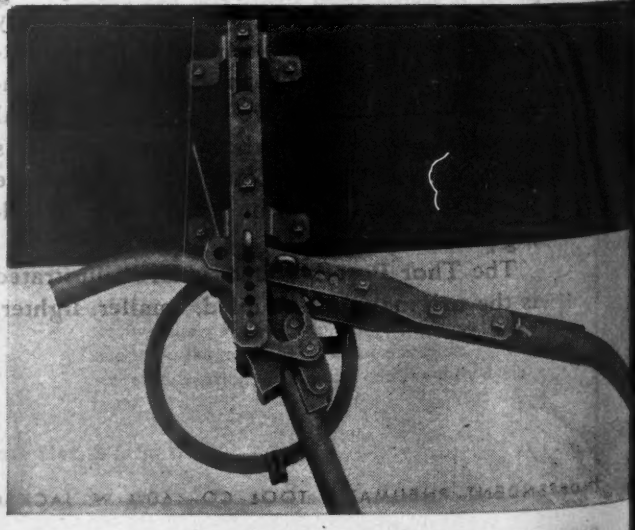
THE ELECTRUNITE BENDER

A one-piece casting designed for use with "Inch-Marked" ELECTRUNITE STEELTUBES to provide the ideal combination for making accurate bends of uniform radius. With it you can predetermine the length of stubs and the distance between back-to-back bends. You can make offset and saddle bends to exact measurements. Basic measurements and instructions are cast into the bender —cannot become lost. Made in three sizes—for ½", ¾" and 1" tubing.



THE HICKEY BENDER

When it is necessary to make bends sharper than Standard Code radius, the STEELTUBES Hickey Bender should be used. This handy tool will produce bends of any desired radius. To insure against kinking, the tube should be "inched" through, not more than 10° being bent at one time. Used with the Mandrel Spring, the Hickey is ideal for stubbing up in concrete. It is made in six sizes—for ½", ¾", 1", 1¼", 1½" and 2" tubing.



THE HOSSFELD BENDER

The standard size No. 2 Hossfeld Bender will make excellent bends in all sizes of ELECTRUNITE STEELTUBES from ½" to 2". New and improved bending dies make it possible to produce full, round, smooth bends in sizes up to 1½" with one sweep of the hand lever. When it is necessary to make quantities of bends in the larger sizes of STEELTUBES, this bender will quickly pay for itself.

will help you use

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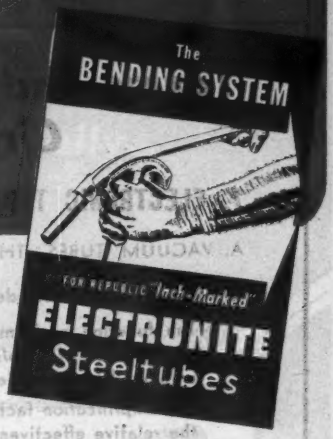

To enjoy the maximum ease and accuracy with which ELECTRUNITE STEEL-TUBES can be worked, you should use the accessories illustrated on these pages.

See your ELECTRUNITE Distributor. He has these accessories in stock and will demonstrate them for you. He also carries a full line of high quality electrical supplies for your convenience.

In the meantime, write for a copy of the booklet, "The Bending System for Republic 'Inch-Marked' ELECTRUNITE STEELTUBES." It's a 68-page book full of helpful suggestions.

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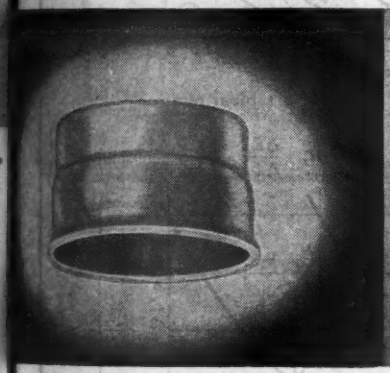

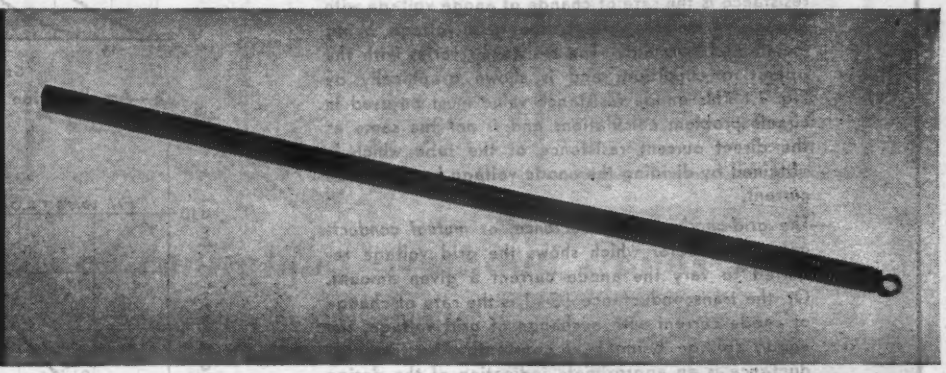

THE END CAP

When using ELECTRUNITE STEEL-TUBES in concrete slab construction, you will find this end cap a handy accessory. It fits snugly over ends of stubs and prevents concrete or other foreign matter from entering. Made in ½", ¾" and 1" sizes.

THE MANDREL SPRING

Short radius bends can be produced in one sweep with the Hickey Bender when it is used in conjunction with the Mandrel Spring in ½" and ¾" sizes. This spring fits inside the tube and acts as a mandrel to prevent kinking. After making the bend, the spring may be removed by backing up slightly on the bend or by twisting the spring. Emergency bends can be made by using the mandrel spring only. This practice should be employed, however, only when conditions make it impossible to use other methods.

REPUBLIC STEEL
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Republic
ELECTRUNITE
Steeltubes

LIGHTWEIGHT THREADLESS RIGID STEEL CONDUIT

DATA SHEET

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D-6

Terms and Definitions Applicable to Electric Circuits and Electronic Tubes

7. ELECTRONIC TUBE DEFINITIONS AND CHARACTERISTICS. (con't:)

A. VACUUM TUBES—THERMIONIC—MISSION

c. Vacuum Triode, Tetrode, and Pentode—Pliotrons

—The function performed by a three-element tube is usually that of *amplification.* Pliotrons are usually employed for amplifier or oscillator operation.

—The *amplification* factor of a tube is the measure of the relative effectiveness of the grid and anode voltages in establishing electrostatic fields at the surface of the cathode. Or, the amplification factor (μ) is shown in Fig. 6 and is numerically equal to the rate of change of anode voltage with change of grid voltage, the anode current being held constant. The geometry of the tube determines the amplification factor.

—The dynamic *anode resistance* (R_a) of a tube represents the resistance that the anode circuit offers to a small increment of anode voltage. Or, the anode resistance is the rate of change of anode voltage with change of anode current, the grid voltage being maintained constant. The resistance varies with the operating conditions and is shown graphically by Fig. 7. This anode resistance value must be used in circuit problem calculations and *is not* the same as the direct current resistance of the tube which is obtained by dividing the anode voltage by the anode current.

—The *grid-anode transconductance,* or *mutual conductance,* is a factor which shows the grid voltage required to vary the anode current a given amount. Or, the transconductance (G_m) is the rate of change of anode current with a change of grid voltage, the anode voltage being held constant. The transconductance is an approximate indication of the design merit of the tube and is usually expressed in micromhos. It is shown graphically by Fig. 8. A tube which has a transconductance of 1000 micromhos (.001 mhos) means that change of 1 volt on the grid produces a change of 1 milliampere in anode current. (Transconductance is the most commonly used term.)

—The amplification factor (μ) dynamic anode resistance (R_a) and the transconductance (G_m) of a tube are related by the following formulae:

$$\mu = G_m \times R_a$$

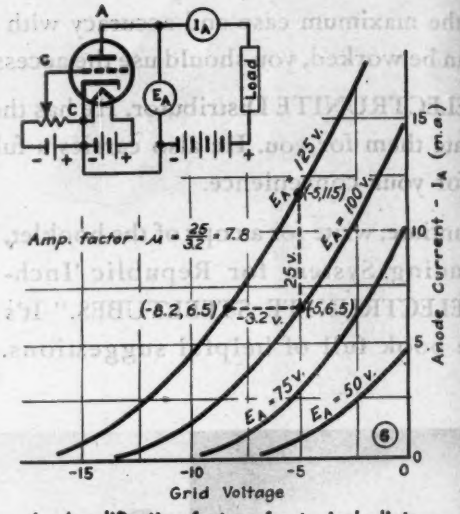
—The *mho* is the unit of conductance and is the reciprocal of resistance. It is also the ratio of the amplification factor to the anode resistance, that is,

$$G_m = \frac{\mu}{R_a}$$

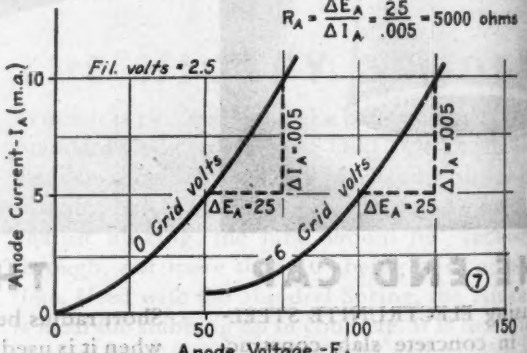
d. Cathode Ray Tube

—The *sensitivity* of an electromagnetically controlled tube is expressed in ampere-turns direct current per inch of deflection of the beam on the screen.

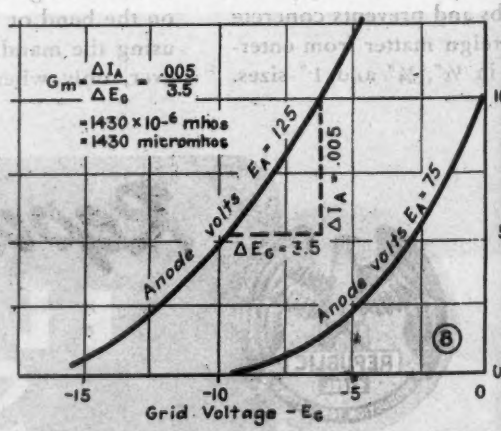
—The *sensitivity* of an electrostatically controlled tube is given in volts direct current per inch of deflection of the electron beam on the screen.



6—Amplification factor of a typical pliotron



7—Calculation of plate resistance for a typical vacuum triode



8—Calculation of trans-conductance for a typical vacuum triode

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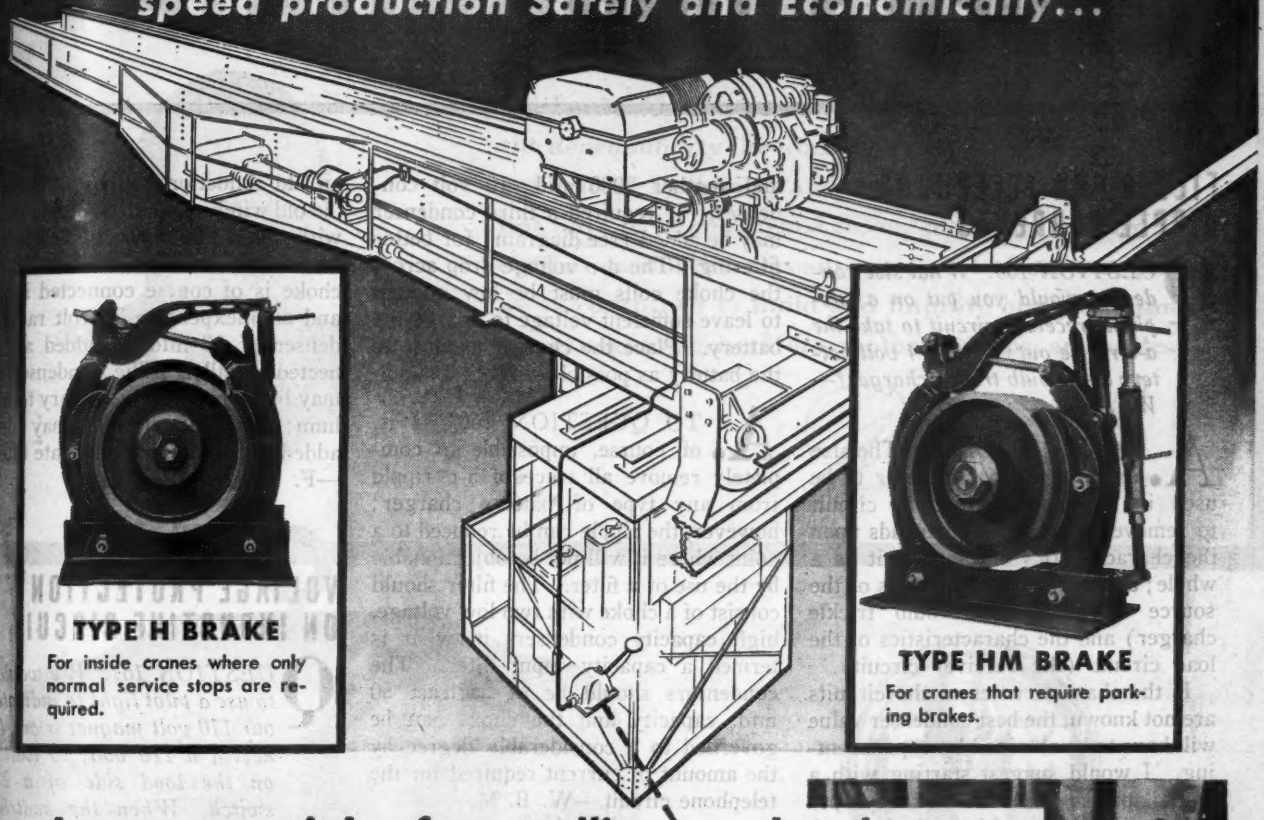

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READER'S QUIZ

FILTER FOR TELEPHONE RIPPLE CURRENTS

QUESTION 160. What size condenser would you put on a telephone receiver circuit to take the a-c ripple out; using a 4 volt battery and a bulb trickle charger?—W. L. C.

A. TO QUESTION 160. The size or rating of a condenser to be used in a telephone receiver circuit to remove the a-c ripple depends upon the characteristics of the circuit as a whole; that is the characteristics of the source of power (the bulb trickle charger) and the characteristics of the load circuit (the receiver circuit).

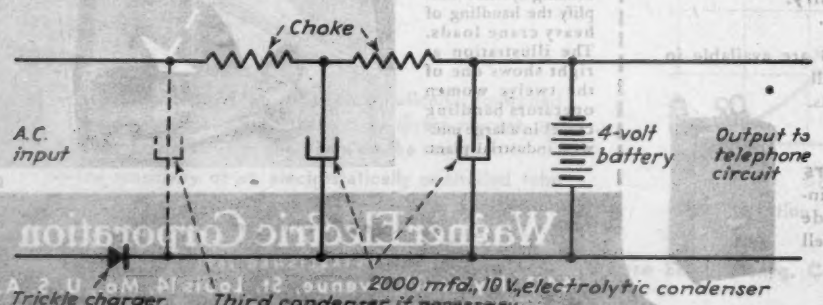
If the characteristics of the circuits are not known, the best condenser value will have to be obtained by experimenting. I would suggest starting with a 4 mfd. paper condenser of the proper voltage value to withstand the peak voltage of the system, connected across the output of the trickle charger or power source. A larger condenser may be necessary to adequately reduce the hum. Since the effect of the condenser on smoothing out the a-c ripple of the power source will depend upon the arrangement and inductance values of the telephone circuit, the condenser may not give you the desired results. It may be necessary to install a low-pass filter at the power source to adequately remove the ripple.—L. H. M.

A. TO QUESTION 160. Between the charger and battery install a choke coil in series and a 2000 mfd., 10 volt electrolytic condenser in parallel. Then add another choke coil and another 2000 mfd., 10 volt condenser. If required a third condenser may be added (see diagram) for better filtering. The d-c voltage drop across the choke coils must be low enough to leave sufficient voltage to charge the battery. Place the charger as close to the battery as possible.—H. S.

A. TO QUESTION 160. It is, of course, impossible to completely remove all trace of a-c ripple from any type of battery charger; however, the ripple can be reduced to a point where it will not be objectionable by the use of a filter. The filter should consist of a choke with two low voltage, high capacity condensers in what is termed a capacity input filter. The condensers should be of at least 50 mfd. capacity and the choke can be governed to a considerable degree by the amount of current required for the telephone circuit.—W. B. M.

A. TO QUESTION 160. The filter should be connected between the battery and the telephone circuit to provide a shunt path for the a-c ripple. The filtering needed will depend upon the amount of a-c hum that can be tolerated. A single pi section filter consisting of shunt condensers of 8 microfarad capacity and a series inductance of about 10 henries should suffice for W. L. C.'s circuit since no amplification is involved.—G. I. S.

A. TO QUESTION 160. In telephone work an open-core choke coil can be used between the charger and battery to take out the a-c ripple. A choke can be made from an old induction coil by stripping off the old winding, and rewinding the core with about 100 turns of bell wire, or better still No. 16 enamel wire. The choke is of course connected in series and an inexpensive 25 volt radio condenser of 10 mfd. is added and connected parallel. The condenser value may be increased if necessary to reduce hum; an identical filter may also be added to obtain more adequate filtering.—F. A.



VOLTAGE PROTECTION ON INDUCTIVE CIRCUIT

QUESTION 161. We would like to use a pilot light to indicate that our 110 volt magnet is on. I connected a 110 volt, 25 watt lamp on the load side of a 2 pole switch. When the switch was pulled, the lamp flared up and went out. I would like to know what caused the lamp to burn out and what to do to correct this trouble.—R. E. P.

A. TO QUESTION 161. The lamp burns out because of the high voltage generated in the magnet winding by the rapidly decaying magnetic field.

If the magnet is shunted with a dry type rectifier unit in series with a resistor of about 75 percent of the resistance of the magnet, the voltage will be limited to a value somewhat below line voltage. This will prevent the lamp from burning out. The rectifier unit must be connected to pass no current while the magnet is connected to the line. Thus, it *will* pass current when the switch is opened since the direction of discharge current will be opposite to that of load current.—G. I. S.

A. TO QUESTION 161. The 110 volt incandescent pilot lamp burned out due to an inductive kick. When a d-c current flows in a coil, especially when the coil is surrounded by iron, as in the case of a magnet, a magnetic field is set up around the coil.

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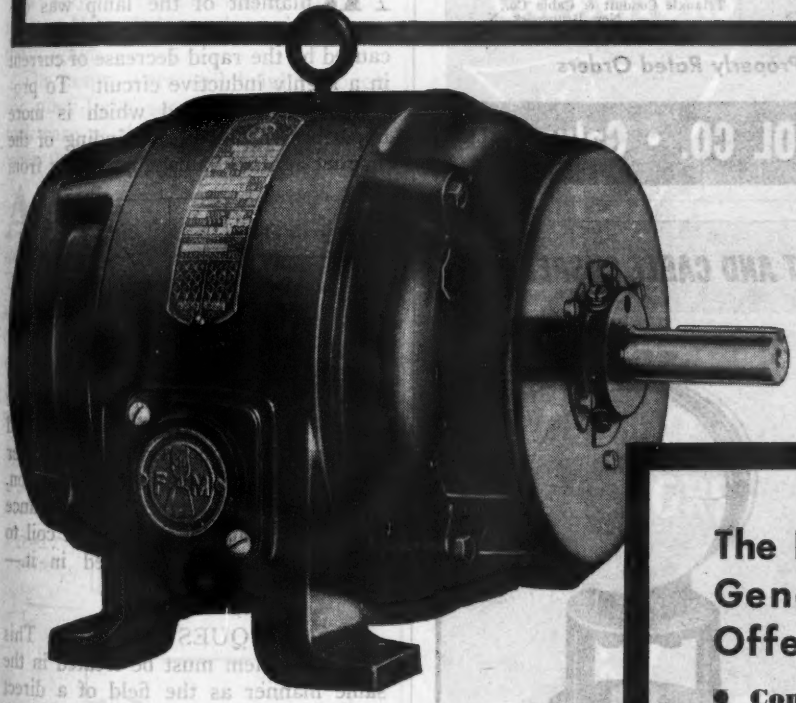

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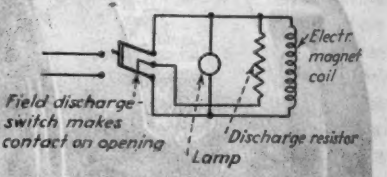
When the circuit is broken this magnetic field collapses, and in doing so induces a voltage in the coil opposite (in direction) to that applied by the source. The magnitude of this induced voltage depends upon the characteristics of both the electrical circuit and the magnetic circuit through the iron, and given the right conditions, it can be many times the 110 v. originally applied to the magnet. This momentary high voltage is the reason your lamp burned out.

For a practical solution to your problem, try using a neon glow lamp in series with a resistor. A 2 watt, 110 volt lamp, with a radio type resistor of around 30,000 ohms at 10 watt rating would be safe up to around 600 volts. If a 1 watt lamp is used, the resistor should be about twice this rating.

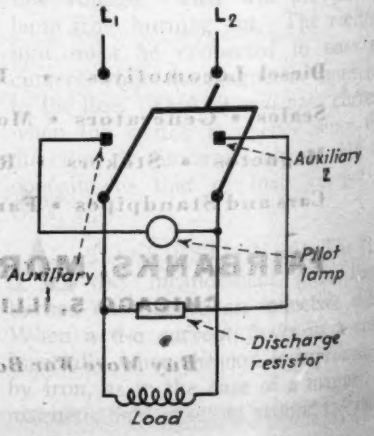
It may require a little experimenting to hit upon the exact combination of neon lamp and resistor to give the best results, but this does provide the logical solution.—W. B. S.

A. TO QUESTION 161. The filament of the lamp was destroyed by an e.m.f. of self induction, caused by the rapid decrease of current in a highly inductive circuit. To protect your lamp—and which is more important, protect the winding of the magnet against damage resulting from



high voltage, it will be necessary to install a discharge resistor. And if the circuit is controlled manually, a field discharge switch connected in a manner shown above will remedy the situation. Upon opening the circuit, a resistance is connected across the magnet coil to dissipate the energy stored in it.—F. C. L.

A. TO QUESTION 161. This problem must be treated in the same manner as the field of a direct current generator. If the circuit is



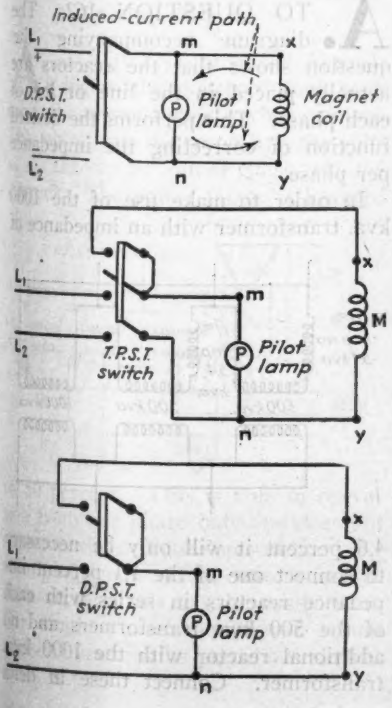
suddenly opened while carrying current, then, due to the rapid decrease of flux through the large number of magnet turns, a high voltage will be induced. Therefore, it is necessary to provide a discharge resistor, which is connected across the terminals as soon as the switch opens. This will protect the magnet coil against insulation punctures due to the high voltage between turns. To protect the pilot light, it will be necessary to disconnect it before the magnet winding is disconnected. All this may be accomplished by using a double pole single throw knife switch with auxiliary contacts. Auxiliary 1 must be placed so that it is disconnected before its blade leaves L 1 and auxiliary 2 must be placed so that it is connected before its blade leaves L 2.—S. G. C.

A. TO QUESTION 161. When the switch is opened, the collapse of the magnetic field cuts its own turns setting up a back electromotive-force far in excess of the lamps rated voltage. This voltage is built up across the lamp causing it to be burned out.

We solved a similar case by connecting two 110 volt lamps in series across the magnet.

The lamps were still bright enough for pilot light service and they also took care of the high induced voltage when the switch was opened.—J. H. G.

A. TO QUESTION 161. When a solenoid is energized, a magnetic flux is set up around the coil. This flux collapses suddenly upon opening the circuit, cutting the conductors of the coil and inducing a counter-emf., which may be extremely high. Since the lamp is connected in parallel with the solenoid a path in formed for



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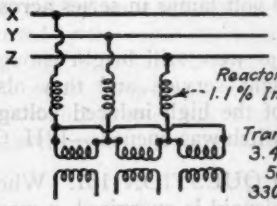
the heavy induced current (caused by the induced voltage) to flow through the lamp causing the filament to melt, destroying the lamp.

A simple solution to this problem is the use of a three pole switch which breaks the path between the coil and the lamp thus preventing the destructive current from flowing through the lamp. The use of the extra pole of the switch is shown below. (The same two pole switch may be utilized if single pole operation appears feasible in the coil circuit.)—W. R. S.

REACTOR CONNECTIONS FOR BALANCED OPERATION

QUESTION 162. We have several banks of transformers all of which are parallel and connected delta-delta. One bank of three 500 kva. units have an impedance of 3.4 percent for each unit. In order to parallel this bank with other banks having a higher impedance a reactor is installed in each phase as

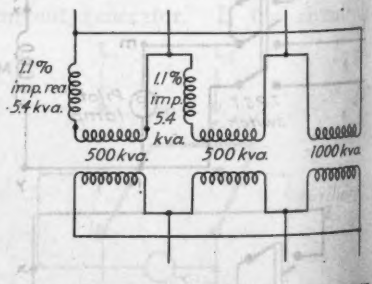


shown in the diagram. If due to failure of one of the 500 kva. units a spare 1000 kva. unit having an impedance of 4.6 percent were used to complete the delta, how would it be connected?.

—*J. A. H.*

A. TO QUESTION 162. The diagram accompanying the question shows that the reactors are actually placed in the line or leg of each phase. This performs the desired function of correcting the impedance per phase.

In order to make use of the 1000 kva. transformer with an impedance of



4.6 percent it will only be necessary to connect one of the 1.1 percent impedance reactors in series with each of the 500 kva. transformers and no additional reactor with the 1000 kva. transformer. Connect these in delta

in the conventional manner as per the accompanying diagram.—G.S.E.

A. TO QUESTION 162. Place enough reactance in the delta between the transformer lead and the line lead to give it correct impedance. —H. S.

TRANSFORMER CONNECTIONS FOR TESTING

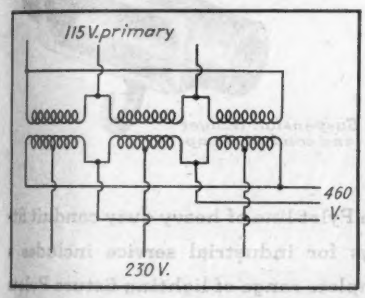
QUESTION 163. From an m.g. set supplying 125 volts, 25 cycles, 230 amperes, we connected a bank of three 10 kva. transformers.

The primary side was connected closed delta, so was the secondary, to give 460 volts.

We also wanted 230 volts from the same bank so that our tester would have available:

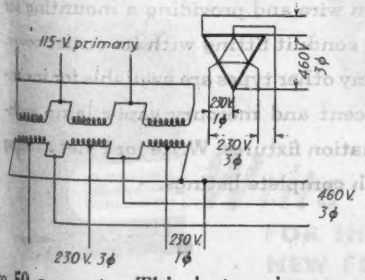
125 volts three phase 25 cycle
230 volts three phase 25 cycle
460 volts three phase 25 cycle

However, when a load of twenty



amperes was applied on our 230 volt line (single phase) the voltage was pulled down to 90 volts. We checked all connections to conform with rating plate. Attached is a sketch of hook up. What caused such a voltage drop?—W. H. L.

A. TO QUESTION 163. According to the sketch of your hook up in these transformers when you use 230 volt taps on the secondary, the voltage is thrown 60° out of phase with the current. The power factor is lowered



to 50 percent. This is true in operation from one phase only and does not apply to three phase operations. By arranging your sketch into a set of delta vectors, this can be easily seen. For single phase operation I would advise connection as per above sketch. —M. W. H.

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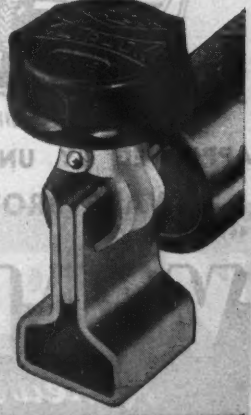

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A. TO QUESTION 163. A load of 20 amperes through the secondary of the transformer (even at 230 volts single phase) will require a current of 80 amperes (plus exciting and loss current) through the primary. This should not be too much load for the 230 ampere 125 volt generator, but the transformer may cause the trouble. A 10 kva. transformer at 125 volts, 100 percent power factor, would carry 80 amperes. With the connection as shown, the load current might be somewhat out of phase (lagging) and this would cause a voltage drop. Drawing the current from only half the winding results in reduction of the voltage on that half and increasing the voltage in the other half of the winding.—J. E. W.

Can you ANSWER these QUESTIONS

QUESTION K7—We recently put a 3 hp., 250 volt d.c. series-wound crane motor into service after rewinding the field poles. The motor seemed to operate satisfactorily with the exception of a bad sparking condition at one point on the commutator. After thoroughly checking the entire motor, we found that both poles (two-pole motor) were connected for the same polarity. Why did this motor run at all and why did it spark so badly at only one point?—F. L.

QUESTION L7—We are thinking seriously of specializing in fractional horsepower motor repair work. Since most repulsion-induction armatures are lap-wound with a cross-connected commutator, what is a quick, practical way to check such windings for coil-to-coil shorts? Conventional type growler and saw-blade tests are very unsatisfactory and raising the top leads makes extra work.—H.G.H.

QUESTION M7—We would like to replace a burned out neon tube transformer rated at 3500 volts, 15 M.A. with another we have on hand rated at 7500 volts, 15 M.A. Will this shorten the life of the tubes, or in any other way affect the operation of the sign?—J.J.L.

QUESTION N7—We have a steam driven generator, 270 rpm., 250 v. d-c, 400 amperes, compound wound non-interpole with hand brush shifting device. We also have a six phase rotary converter, 200 kw., 250 v. d-c, 800 amperes, 750 rpm. I would like to know if it is possible to run these two machines in parallel. If this is possible, how would it be done? Would each take an equal share of the load, or would each take a share proportional to its capacity? How can an equalizer bus be connected properly?—R.J.

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GROUNDING CONNECTOR

Q. *"While replacing the cable containing light and control circuits for an elevator, I was surprised to note that the cable did not contain a grounding conductor even though the face of the control panel on the car was metal attached directly to a metal box. Is it not necessary to run a separate grounding conductor with this cable to properly ground this electrical equipment?"*—H.P.

A. On most elevator installations the elevator hoisting drum is properly grounded, the cars themselves have metal frames and the cables supporting the car are steel. When such conditions are encountered, it is not necessary to provide a special grounding conductor as the path to ground is assured via the car frame, supporting cable and hoisting drum. The N. E. Code permits this means of grounding under Sections 2557 and 6275. It is, however, entirely possible that such a condition does not exist on the elevator you have repaired, and if the continuity to ground is interrupted in any manner, a grounding conductor should be included in the traveling cable.—G.R.

BONDING JUMPERS

Q. *"During the rewiring of a large terminal grain elevator, it was necessary to place expansion fittings in several long conduit runs. After finishing this job, we were told that the expansion fittings would have to be provided with bonding jumpers. Are these jumpers required even though approved expansion fittings are used?"* —J. S. T.

A. Yes, the electrical continuity of the conduit system must be assured by the use of bonding jumpers when expansion fittings are inserted in conduit runs. Section 2575 of the National Electrical Code reads as follows: "Expansion joints and telescoping sections of raceways shall be made electrically continuous by bonding jumpers or other approved means."—G. R.

MORE NON-METALLIC SHEATHED CABLE

Q. *"In a permanent housing development, (to amortize, the Government has set 58 years) exterior walls are brick (nine inches) first floor (concrete) first floor interior partitions (cinder block), roof is slate covered, this above is given to show different construction from the so called "Emergency War Housing".*

"The project specifications are explicit in two paragraphs, as follows: A—Non-metallic cable (bare or covered neutral) shall not be used with metallic outlet boxes, B—Non-metallic cable shall not be installed in contact with masonry. Conduit sleeves are used in and thru masonry walls, but at front and back doors (outside walls) ⅝" furring strips are used on masonry wall to receive laths and plaster. This furred space will not accommodate non-metallic cable without cable being in contact with masonry.

"A and B as noted above were listed as non-compliances as the non-metallic sheathed cable used is SIN (semi- insulated neutral).

"May I have your comments on this matter?"—F.A.

A. As this project is a permanent housing development as indicated by the 58 year amortizing time (at the end of which time none of the present electrical equipment would be of much use or value) the buildings could not be classed as "defense emergency buildings" within the meaning or intent of Interim Amendment No. 43 and therefore the National Electrical Code would not permit the use of "non-metallic sheathed cable having one circuit conductor without individual insulation".

On the other hand the SIN cable is manufactured as a "Trial Installation Cable" and is not recognized as the cable mentioned in Interim Amendment No. 43. This "Trial Installation Cable" could only be installed by special permission from the inspection bureau having jurisdiction under restrictions set up by resolutions passed by the Electrical Committee of the NFPA at its 1935 meeting. It is not approved for general use.

However, if the inspection bureau having jurisdiction granted permission for a trial installation using "trial installation cable", such as SIN, the use of metallic outlet boxes would not be prohibited.

Therefore, the Code would require the use of the fully insulated cable and either metal or non-metallic boxes could be used as permitted in Section 3369.

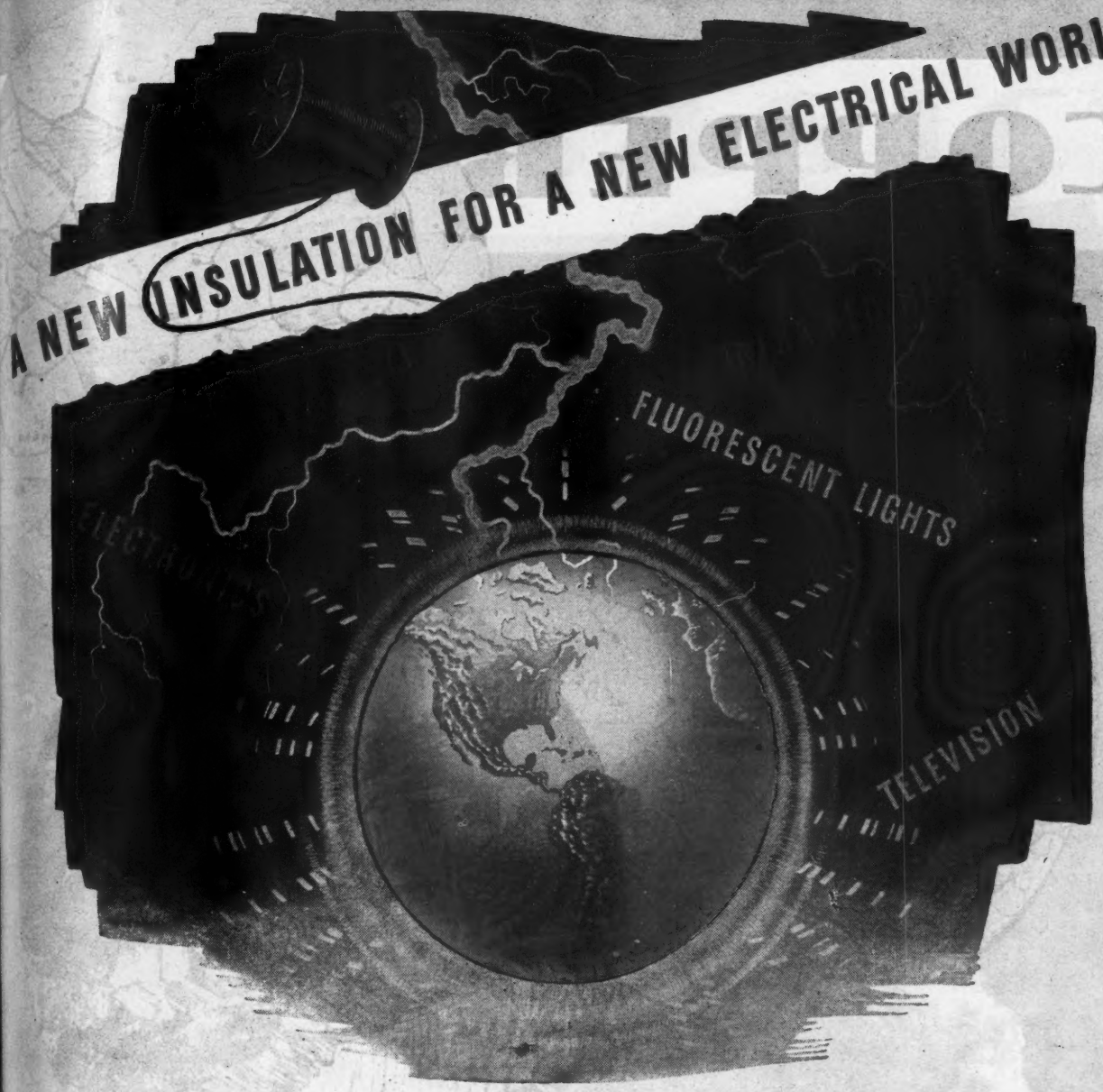
The Code, in section 3362, states that "non-metallic sheathed cable shall not be *embedded* in masonry, concrete, fill or plaster". Laying the cable in the furred space is not embedding it in the masonry so there could be no objection to using it as described and "Official Interpretation" No. 220 bears out this use of the cable as it states that there is no violation when non-metallic cable is laid in a chase cut in masonry and the chase covered over with building paper. In such a chase the cable would be in contact with the masonry although not embedded in it.

The furred space constitutes a dry air space similar to the chase mentioned above and the cable here is not fully "embedded" in either the masonry or the plaster although it probably is in contact with both.—F.N.M.S.

DISCONNECTING SWITCHES

Q. *"May a general-use switch* rated at 90 amperes be used *as the disconnecting switch for group of ½ hp. motors having a combined rating of 42 amperes?"*—H. M.

A. No, a switch rated in horsepower must be used even though the N. E. Code does permit the use of a general use switch as the dis-



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A Grain structure of annealed hard drawn wire—X1500

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connecting means for a motor of less than 2 hp. Under Section 4410 we find the following: "Each motor shall be provided with individual disconnecting means, except that for motors of 600 volts or less a single disconnecting means may serve a group of motors under any one of the following conditions. The disconnecting means serving a group of motors shall have a rating not less than is required by Section 4402 for a single motor whose rating equals the sum of the horsepowers or currents of all the motors in the group. Section 4402 requires the use of a disconnecting switch rated in horsepower for motors rated at more than two horsepower.—G. R.

MOTOR PROTECTION

Q. *"It has been our understanding that totally enclosed motors (50 degrees) are built to take the normal full load only for an indefinite period, and hence cannot take a 25 percent overload like the normal open type 40 degree motor. On the open type motor we are using over current protection of 125 percent of the full load rating of the motor as per Code 4322. On the enclosed motors we have been recommending protection not to exceed 110 percent (some instances have gone to 115 percent). Where is this covered in the National Electrical Code?"—H. H. H.*

A. It is true that the 40 degree open type a-c motor can stand more current than the totally enclosed type and can therefore be considered as protected against over current with an over current device at a higher percentage of the motor rating than the enclosed type. It is also true that the percentages given in the above question provide better protection than higher percentages.

The National Electrical Code, however, is more liberal. In Interim Amendment No. 72, approved September 10, 1942, it states that "A continuous duty motor rated more than one horsepower shall have running over current protection not greater than 125 percent of the full load current rating of the motor, *except that a 40 degree, open-type, alternating current motor* may have over current protection not greater than 135 percent of the full load current rating of the motor."

Thus the enclosed type of motor is considered as being protected by fuses at 125 percent of the running current while the open type of motor is considered as receiving the same degree of protection with fuses at 140 percent of the current rating of the motor. —F. N. M. S.

APPLIANCE OUTLETS

Q. *"On farms many dwellings have combination dining and living rooms, and we have made a practice of connecting at least one outlet in each such room to the appliance circuit. We have no control over the use of this outlet after it has been installed and recently an inspector has requested that we make some changes at one farm because he found a table lamp attached to the appliance outlet. What would be the proper Code ruling governing location of appliance outlets in this type of room?"*—R. S.

A. This question cannot be answered by reference to the N. E. Code as no reference is made to the combination type room. This problem is also found in many urban dwellings where the dining space is part of the living room. The proper procedure to follow in obtaining an answer to your problem would be to direct this question to Mr. A. R. Small, Chairman of the N. E. Code Committee, 207 East Ohio Street, Chicago 11, Illinois and request an official interpretation, and be sure to accompany your request with six copies of the problem.

In this area we have found our own answer to this problem by determining the location of the dining room table in the combination type room and then placing the appliance outlet as near that location as practicable. As far as controlling the eventual use of such an outlet is concerned, it presents no more problem here than it does in the kitchen. In other words, as long as ordinary 15 ampere receptacles may be connected to appliance circuits ordinary attachment caps will be inserted regardless of the end use of current. It may be a miniature radio or an electric roaster.—G. R.

THIN WALL CONNECTORS

Q. *"We were recently supplied with some thin wall connectors that do not bear any identifying marking. What assurance have we that the inspector will accept these connectors as approved wiring material?"*—E.H.

A. You have no assurance that such a connector would be acceptable to the inspector. In fact, a manufacturer producing connectors

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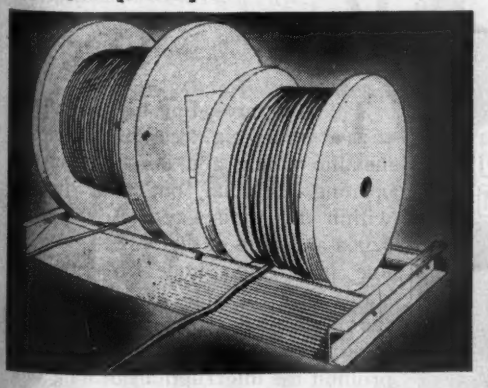

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that cannot be identified is violating Section 1117 of the N. E. Code which reads as follows:

"The maker's name, trademark or other identification symbol shall be placed on all electrical equipment."

Obviously a connector or any other piece of wiring materials or device bearing no identification must be considered as unapproved by an inspector. A considerable number of these unmarked electrical metallic tubing connectors have appeared in the north central area as several contractors at widely separated points have sent in samples complaining of the sharp edges and rough wireways.—G.R.

FASTENING CONDUIT TO CABINET

Q. *"Is it true that the Code forbids the use of lock nut and bushing means of fastening a conduit to a cabinet or outlet box when the conduit contains a 440 volt circuit?"*—J.A.

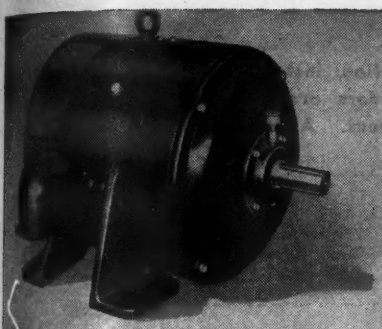
A. Yes, electrical continuity of metal raceways or metal sheathed cable which contains one or more conductors carrying more than 150 volts to ground must be assured as directed by Section 2574. These methods are as follows:

1. Threaded fittings, with joints made up tight.
2. Threadless fittings, made up tight.
3. Approved bonding jumpers.
4. Two locknuts, one inside and one outside of boxes and cabinets.
5. Other devices (not locknuts and bushings) approved for the purpose. —G.R.

FEEDER RUN IN ELEVATOR SHAFT

Q. *"May a feeder run be placed in an elevator shaft when it does not supply the elevator?"*—D.T.

A. Yes, providing it is installed in either rigid conduit or electric metallic tubing and does not have an opening, terminal, outlet or junction within the hoistway. See Sections 6206a and 6218 of the N. E. Code. The fine print note under Section 6218 states that the rule prohibiting openings, terminals, outlets or junctions within the raceway is not intended to prohibit the interruptions of long vertical runs for the purpose of support as required by Section 3037 or by pull boxes found necessary for the proper installation of the conductors.—G.R.



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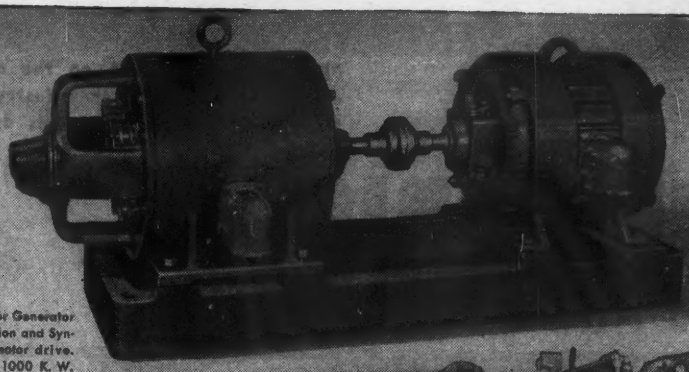

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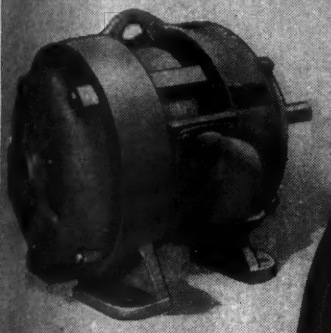

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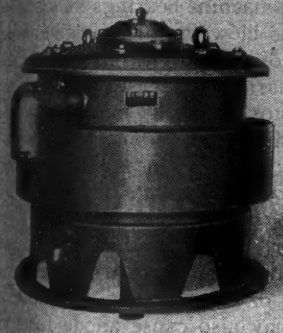

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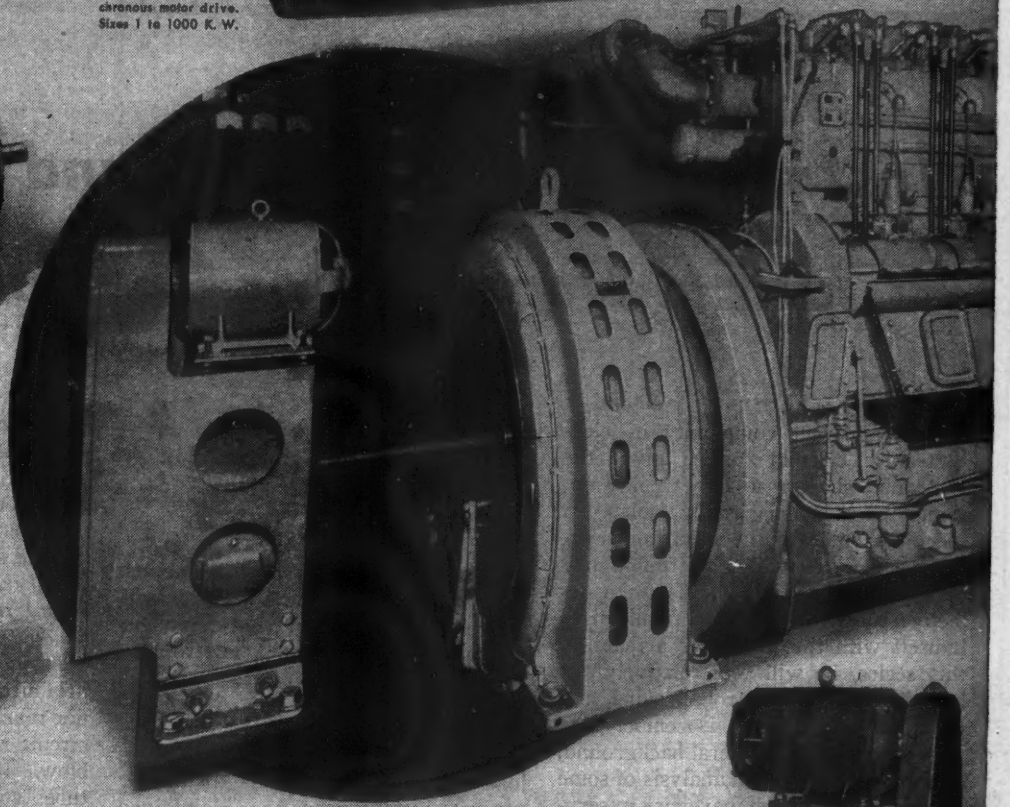

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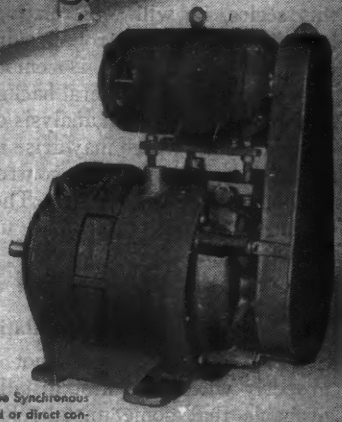

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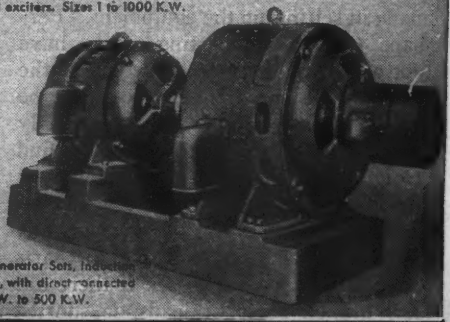

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PRACTICAL ARTICLES on the application, installation and maintenance of electronic apparatus in industry. Readers are invited to contribute items from their experience to this department. Articles used will be paid for.

ELECTRONICS

Installation Maintenance and Servicing of Electronic Motor Control—III

By B. J. Dalton
Industrial Engineering Division
General Electric Company

THE apparent complexity of electronic circuits often give the trouble-shooter a few trepid moments when he has finally isolated a specific trouble to the electronic control system. Actually the trouble may be as simple as a blown fuse or a defective tube. If a person familiarizes himself with the preceding articles in this series, he will feel relatively "at home" with an electronic panel and diagram. With the December and January articles as general background, let us go ahead with an analysis of some of the troubles which may arise in servicing electronic motor control, and methods of finding them. The same general approach may be used in trouble-shooting any type of control employing electronic circuits.

Trouble in Initial Installation

If a motor drive will not operate properly when it is first installed it is probable that some mistake has been made in setting up the equipment. Perhaps the interconnecting wires have not all been connected according to the diagram, or one or more tubes may be in the wrong sockets. At this early stage one should not expect to find trouble in the panel itself, unless it has been damaged in shipment or through mishandling. If there is any indication of panel damage, all parts should be inspected to see if there are any broken parts or leads or shorted terminals.

There may be exceptional cases where an equipment will not perform properly when all installation work has been done correctly. The various approaches discussed later will be of help in these cases.

Common Troubles

Looking first for simple troubles (which are most likely to happen) will often save time and prevent confusion in looking for more complex troubles that do not exist.

OVERLOAD RELAY

If the motor suddenly stops, the overload relay, which protects the motor against instantaneous or maintained overloads, is one of the first things to suspect. After the few seconds required for most relays to reset, the motor may be restarted by merely pushing the "start" button if the relay is of the automatic reset type; or by first manually resetting the overload relay and then pushing the "start" button if the relay is manual reset.

An occasional tripping of the overload relay may not indicate any other trouble. The cause of continual tripping, however, should be investigated because it may be a sign of tight machine bearings or a badly overloaded motor. If the room temperature is too high the relay is likely to trip at a lower motor load than in a colder room. A defective armature rectifier tube or a blown fuse might also cause the overload relay to trip.

FUSES

If the motor will not run, and none of the tubes are lighted, the chances are good that there is a blown fuse in the primary of the anode transformer. If the tubes are lighted, however, the trouble is elsewhere.

Frozen machine bearings may stall a motor and blow the fuses in the anode circuits of the thyratron tubes. A frozen bearing may easily be found on small motor drives by manually rotating the shaft. (*An important precaution here is to open the line switch before trying to rotate the motor by hand*).

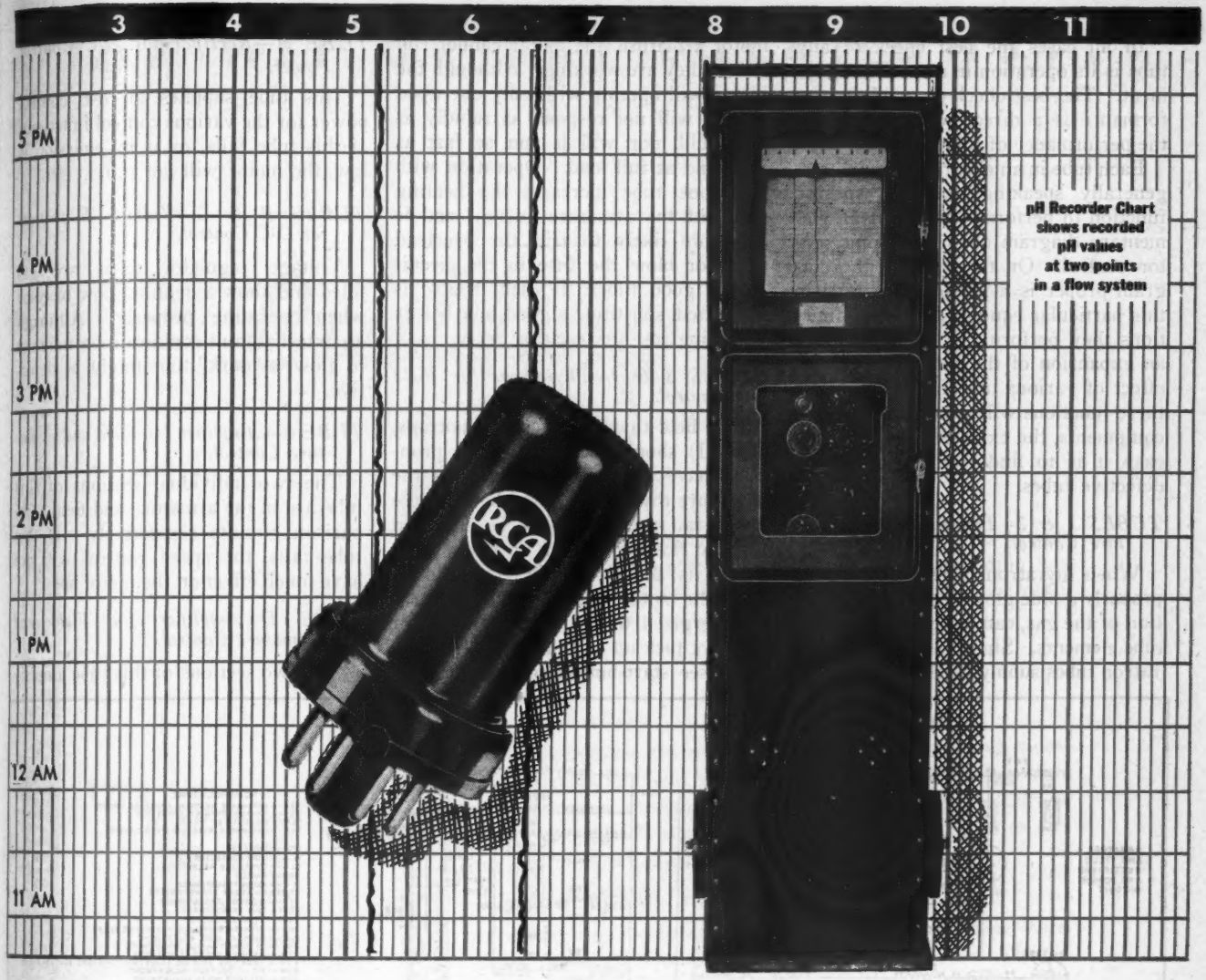
A short circuit in the armature or field circuit, a defective armature rectifier tube, or a fault in the current-limit circuit may also cause anode fuses to blow. If a fuse is blown the thyratron tubes connected to its circuit will not show the characteristic glow of a gas filled tube.

TUBES

Several ways in which tubes can fail are—open filaments, loose or shorted elements, or lack of emission. A tube with an open filament is easily found because the tube will fail to light and no red glow will be seen in the envelope.

Tubes with loose or shorted elements are more difficult to find because the trouble is not apparent from the outside. Although the performance of the equipment will indicate this type of failure, a sure check is the substitution of a good tube. Sometimes tube elements are intermittently loose or shorted. Intermittently defective tubes may be found by tapping the tube lightly with a block of wood or the head of a screwdriver and observing the effect on the control performance.

A gradual loss of "emission" from the tube cathode as the tube ages will effect the performance of the power or control rectifier tubes or any others carrying fairly large currents.



pH Recorder Chart shows recorded pH values at two points in a flow system

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How It Works: In the electronic pH recording system, a glass electrode is immersed in the solution at each point to be measured. The ion concentration, or pH, of the solution produces an electrical potential between the electrode and the solution. Measurement of this minute potential . . . made possible by RCA amplifier tubes . . . indicates the pH of the solution. As many test electrodes can be used as are needed to give accurate, continuous control of the pH of the entire flow system. The electrodes are connected electrically to the central control point, which may be located anywhere.

Applications: The electronic pH recorder makes possible accurate control of the acidity of boiler water feed, corrosion in oil refineries, carbonation in sugar refineries, fermentation in breweries and distilleries, and at numerous stages in the manufacture of paper and textiles.

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In all cases the best check of any tube is its operation in a specific equipment. The best check on a tube's performance is a direct comparison with the performance of a known good tube.

Each tube in an electronic equipment, generally speaking, has one specific function to perform. Fig. 1 is an elementary diagram of an electronic motor control. On the right of the diagram proper is a list of tubes used in this particular equipment and the functions they perform. The following is an expansion of the functions and the effect of various tube failures. While these functions will vary with different equipments, the examples indicate how easy it is to find troubles caused by defective tubes.

TUBES 1 & 2—Thyratrons for Armature Control.

When thyratron tubes are operating properly a blue glow, indicating ionization of the gas, can be seen between the tube elements. Since the armature thyratron tubes supply all the power to the motor armature, the motor cannot run unless they are working. Although the motor will operate with only one good tube it will not respond as rapidly as it should, nor will it run as fast as it should at full load. Operation with only one tube increases the heating value of the armature current and is therefore likely to trip the overload relay or blow the fuse in the circuit of the good tube. If such trouble is suspected, substitute a good tube before replacing fuse or resetting relay.

TUBES 3 & 4—Thyratrons for Field Control.

The field thyratrons (or phanotrons, if used) should, when operating properly, have the same blue glow as the armature thyratrons. If either of these tubes fail there will not be sufficient current flowing to pick up relay FLR, which is shown in Fig. 1, in series with the motor field. With relay FLR de-energized the motor line contactor will not pick up and the motor will not run (see start-button control circuit).

TUBE A—Rectifier for D-C Control Power.

This tube supplies all d-c control power for the various control functions. If this tube fails, or if its emission is low, the motor will not run.

TUBES B & G—Voltage Regulators for D-C Control.

Voltage regulator tubes are gas filled and show a definite glow of color when operating properly. Although an external fault could cause a tube not to glow, a "dark" tube might be defective.

TUBE C—Amplifier for Field and Armature Control.

The two individual sections of this tube are in the armature and field comparison circuits respectively. If this tube fails, the speed control will not have much effect on the motor speed.

TUBE D—Amplifier for Field and Armature Control.

The two sections of this tube amplify

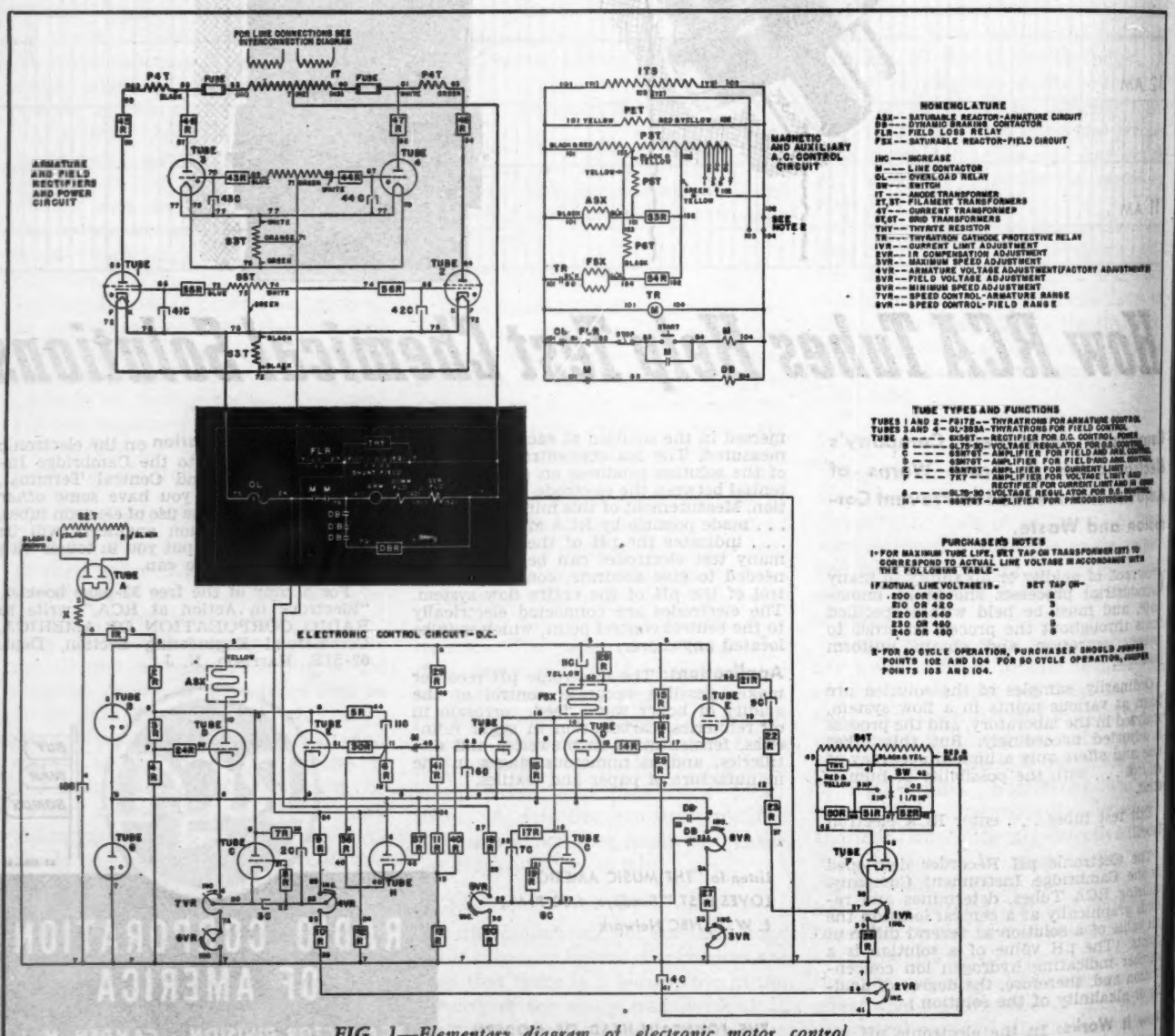
ARMATURE AND FIELD RECTIFIERS AND POWER CIRCUIT
MAGNETIC AND AUXILIARY A.C. CONTROL CIRCUIT
ELECTRONIC CONTROL CIRCUIT - D.C.
NOMENCLATURE
TUBE TYPES AND FUNCTIONS
PURCHASER'S NOTES

FIG. 1—Elementary diagram of electronic motor control.

FOR WET OR DRY LOCATIONS . . .

HAZAKROME

Building Wire

TYPE **SN**

is designed for ordinary locations in buildings of all types.

TYPE **SNW**

is designed for moist locations in accordance with Section 3035 of the N. E. C.

Insulation and protective sheath are combined in Hazakrome Building Wire. Its plasticized synthetic resin insulation has proved itself in over five years of service to the building trade, providing outstanding advantages in:

1. INSULATION

A non-flammable thermoplastic, Hazakrome is oil and chemical-resistant and will not oxidize or sun-check. It has high dielectric and mechanical strength, and its aging qualities insure long life. It contains no fibrous braids or tapes to rot, no saturants to flake off or soften.

2. NEW WIRING and REWIRING

In addition to requiring no braid, Hazakrome Building Wire has a lighter wall of insulation than Type R Wire. Thus a greater number or larger sizes of wires can be pulled in old buildings, and new buildings can be adequately wired for heavier copper for future needs without increasing conduit costs.

3. EASY HANDLING

The smooth, hard glossy finish makes Hazakrome easy to pull. It strips clean for splicing and soldering. Thin-wall insulation produces light weight wire that is easy to handle.

4. SIZE and IDENTIFICATION

Hazakrome small diameter Building Wire is available in all standard sizes up to 2,000,000 CM, and in a wide range of colors. It is suitable for an entire wiring system.

Types SN and SNW, sizes from 14 to 4/0, are approved by Underwriters' Laboratories. Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pa.

HAZARD

insulated wires and cables for every electrical use

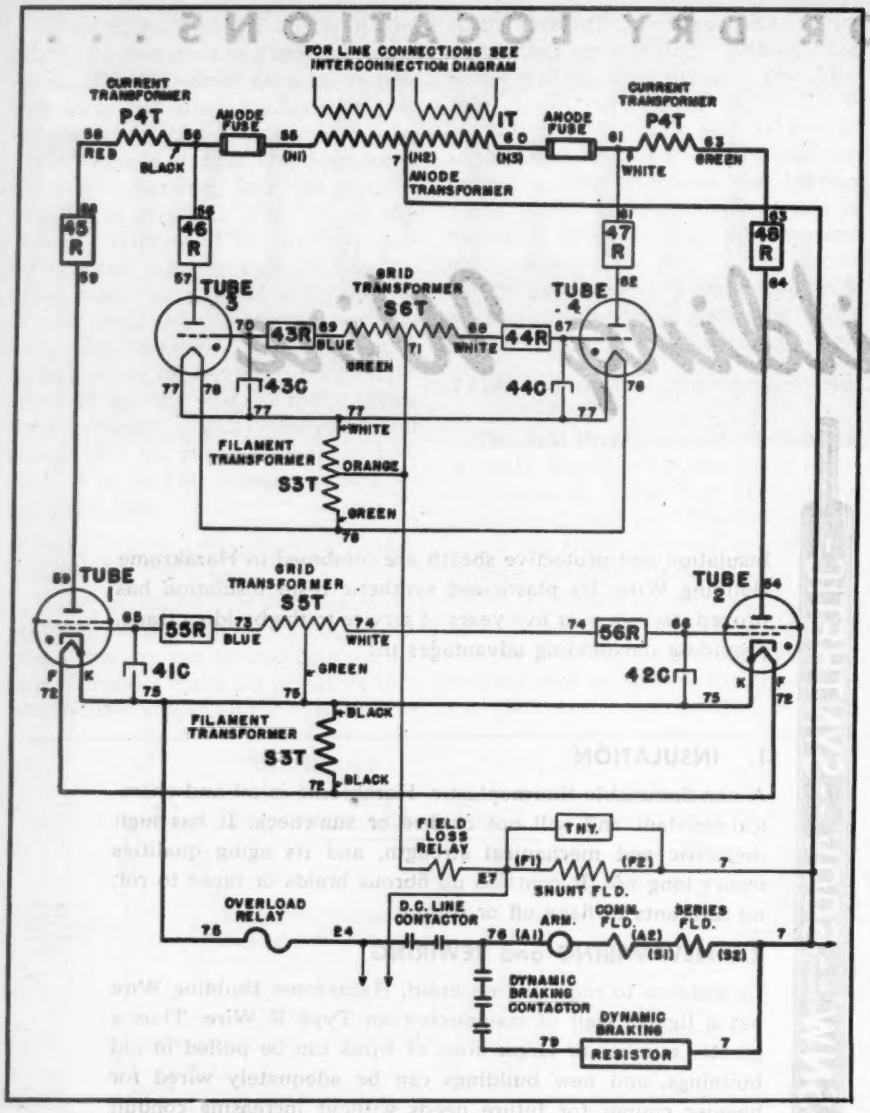

FIG. 2.—Armature and field rectifiers and power circuits and A. C. control.

and invert the phase of the signals from tube C. A failure of this tube will stop the motor.

TUBE E—Amplifier for Current Limit.

This tube controls both the armature and field voltage during acceleration or overload on the motor. If it fails, the motor will start with high armature current and torque peaks. Repetitive starting with this tube defective may blow the anode fuses.

TUBE F—Amplifier for Voltage and Limit, and Rectifier for Current Limit and IR Compensation.

A failure of this tube will appear similar to a failure of Tube E. At low speeds, however, the motor will not have much torque because the IR drop compensation, which is effective primarily at low speeds, is a function of Tube F.

TUBE H—Amplifier for Preconditioning.

The effect of the loss of this tube is similar to the failure of Tube E, but will not result in as severe current peaks as if Tube E had failed.

OTHER POSSIBILITIES

Occasionally failure may occur in some of the panel components. Sometimes these are readily apparent. For example, a filament transformer may develop an internal short circuit which will result in overheating. Smoke from the transformer will "give this away". A rectifier tube socket or other socket with fairly high voltage across its terminals may flash over and carbonize the insulation between terminals. This can be seen by a black path between terminals which will glow and smoke when power is on.

Because transformer, reactor, and resistor overheating may be caused by other troubles, such as a short circuited capacitor or shorted terminals, it is well to test the associated circuits and correct any other defects before applying power again; otherwise, the replacement may burn up again.

A defective timing relay, dirty or broken relay contact tips, broken wires or any other obvious troubles should also be considered as possible causes of trouble.

If the panel is in a very hot location, the thyratron tubes may misfire and the motor performance will be erratic. If the location is too cold, on the other hand, the tubes may not fire at all and consequently the motor may not run. The temperature requirements of all tubes are not the same, therefore the instruction book covering a specific equipment should be referred to for any temperature limitations.

Circuit Analysis

Because practically all troubles in electronic motor control can be found without making a detailed panel circuit study, this study should be considered only as a last resort. In making a circuit study it is not necessary to jump right into the middle of the panel diagram, because the entire circuit can be broken into several simple circuits which can be readily analyzed. As mentioned before, each tube has a function to perform . . . likewise each circuit has a function to perform and the circuits may be divided in accordance with their functions. For example, Fig. 1 shows how the elementary diagram can be divided into three major divisions—(1) armature and field rectifiers and power circuit; (2) magnetic and auxiliary control circuit; (3) electronic control circuit.

ARMATURE AND FIELD RECTIFIERS AND POWER CIRCUIT

Although the armature and field rectifiers, which are shown in Fig. 2, are dependent upon the other circuits for some phases of their operation they may be considered as a complete circuit. Because all motor power passes through these circuits we should start herein any circuit study. One must be careful not to take anything for granted in this study because it is quite possible that a very obvious trouble may easily be overlooked.

FIELD RECTIFIER

To simplify these circuits still further let us consider for the moment the field rectifier alone. The field rectifier circuit consists of the anode transformer, anode fuses, surge resistors, 46R and 47R, tubes 3 and 4, grid transformer 6T, filament transformer 3T, and grid resistors and capacitors 43R and 44R, and 43C and 44C, respectively. This much is the rectifier proper. The load circuit which consists of the field loss relay and the motor shunt field with thyrite discharge resistor is, however, equally important.

A Standout Among Motor Starters . . .

because of its COMPENSATED OVERLOAD RELAY

ONLY OVERLOAD CAN TRIP THIS COMPENSATED RELAY

Monitor's unique Compensated Overload Relay (above) consists of two bi-metal thermally-activated helices. When activated by ambient temperatures, they oppose and nullify each other. Thus, no tripping action is imparted. HOWEVER — one helix is surrounded by a "heater coil" through which flows motor current. When motor current becomes excessive due to overload, the temperature rises in the heater coil . . . is then impressed upon the ONE helix. This produces the motion necessary to open the tripping contact and disconnect the motor from the line.

The Monitor Thermaload V Solenoid Motor Starter . . .

The advantages of Monitor's Thermaload V—with its compensated overload relay—are much too big to overlook. That's because this unique relay—an exclusive Monitor feature—assures thoroughly efficient starter performance regardless of installation peculiarities. For example, in hot locations, the nuisance of unjustified shutdowns is eliminated. In cold locations, this ingenious relay guarantees certain protection against overload. This means that your motors are permanently safeguarded against damage . . . that production schedules can be met without the handicap of unnecessary, periodic interruptions.

In addition to its Compensated Overload Relay, Monitor's Thermaload V starter brings you other important advantages, including (1) Interchangeable coils for different voltages, (2) Double-break silver-to-silver contacts, (3) Tamper-proof reset button, (4) Accessibility of parts for easy maintenance, (5) Built-in quality, (6) Resilient mounting.

Before buying your next motor starter, be sure to get the story on the ingenious Thermaload V from the Monitor Field Engineer in your locality. Or, if you prefer, write us direct for descriptive Catalog 6300.

WE CAN SUPPLY YOU

with the Thermaload V under existing priority regulations from our present stock. Available for motor ratings up to 3 H.P., 110 Volts, A.C. and up to 7.5 H.P., 550 Volts, A.C. Furnished also in combination units . . . combined starter and disconnect switch or combined starter and circuit breaker . . . choice of general purpose, dust-tight or water-tight enclosure. Mounting suitable for front-of-board or back-of-board wiring.

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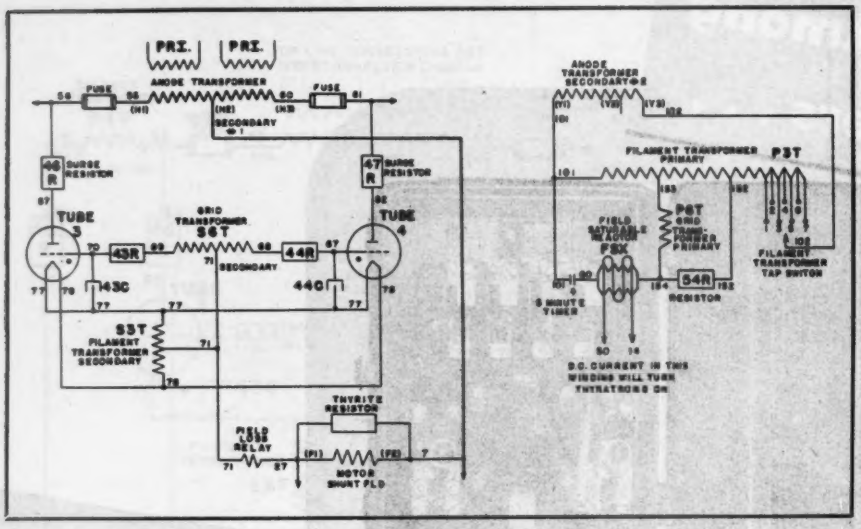

FIG. 3—Grid controlled field rectifier with phase shifting bridge.

NO VOLTAGE

If the filaments of Tubes 3 and 4 are lighted we can be sure that there is *primary* power on the anode transformer and that the filament transformer 3T is good. If the field loss relay will not close, a systematic check of voltages should be made. D-C voltage at the motor field terminals with no current flowing would seem to indicate an open motor field. The presence of voltage between points 7(—) and 71(+) with no voltage across the shunt field indicates an "open" coil in the field loss relay.

If there is no d-c voltage between points 71 and 7, the a-c voltage between point 7 and points 55, 56, 57, 60, 61 and 62, respectively, should be measured. Perhaps there is a broken transformer lead or a defective fuse or resistor. With approximately 300 volts between terminals 7–57 and 7–62, respectively, and yet no d-c output, the trouble must be either in the tubes or in the grid-firing circuits ahead of grid transformer 6T.

Except for broken connections or troubles ahead of transformer 6T, all causes of lack of voltage have been covered.

VOLTAGE WITHOUT CONTROL

Since the grid circuit is responsible for the rectifier control, a failure of any of the grid circuit components could cause a loss of control over the d-c output voltage to the motor field. The resistance of resistors 43R and 44R, capacitors 43C and 44C, and the secondary winding of grid transformer 6T, should all be measured to be sure they fall within the limits given in the part two article of this series published last month. If these components are found to be good and no loose connections are apparent then the trouble is probably ahead of the grid transformer.

ARMATURE RECTIFIER

A further study of Fig. 2 will show that although the numbering of components is different, the armature rectifier circuit is practically identical with that of the field rectifier. The only real differences between the two are the current transformer windings 4T in the anode circuits and the load circuit which consists of an overload relay, a d-c line contactor, and the motor armature circuit with its series and commutating fields and its dynamic braking resistor and contactor.

To the causes for no voltage (given under the field rectifier) can be added an open current-transformer winding and open contacts or broken connections in the armature circuit. The causes for lack of voltage control (through faulty grid-circuit operation) are the same as in the field rectifier.

MAGNETIC AND AUXILIARY A-C CONTROL CIRCUITS

The magnetic and auxiliary a-c control circuits may also be considered as a separate part of the entire circuit, although as in the case of the rectifier, the operation is somewhat dependent on other circuits.

Filament transformers 2T and 3T as well as the phase shifting bridges, the timing relay, and the other magnetic control devices receive all power from an auxiliary 110 volt control winding on the main anode power transformer. An open circuit in the power transformer will prevent operation of any of the control circuits.

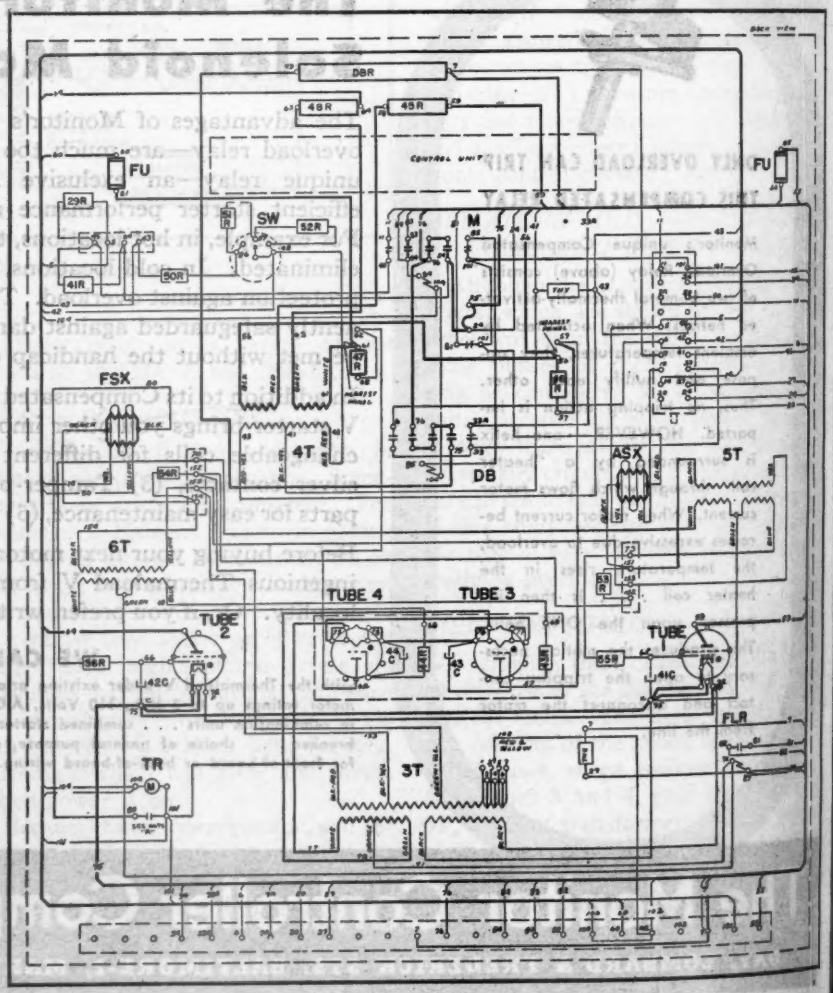

FIG. 4—Wiring diagram of electronic motor control.

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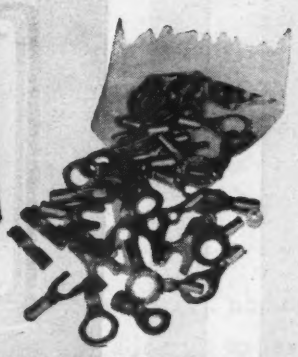

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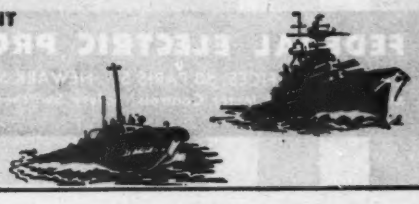

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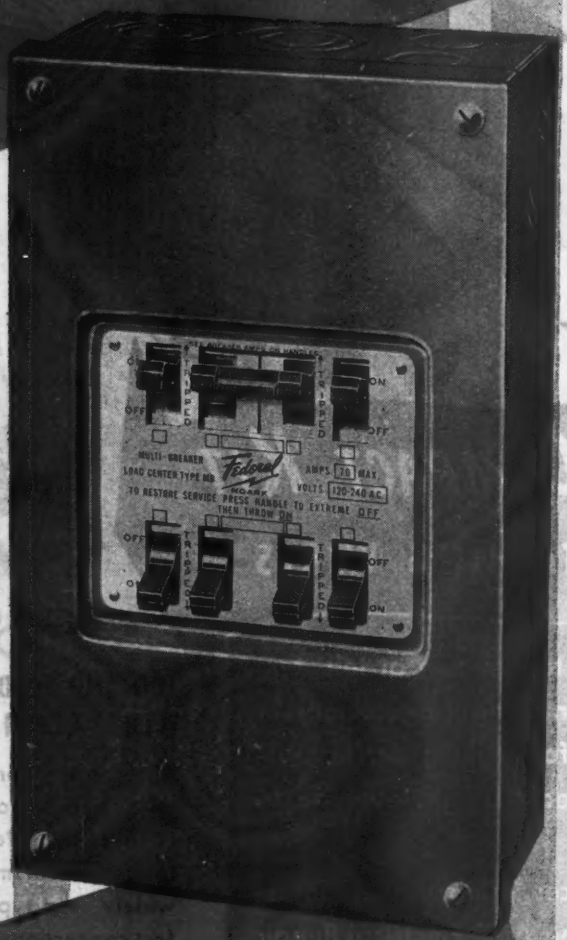

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PHASE SHIFTING BRIDGE

The a-c phase shifting bridge is probably the only part of the a-c control circuit that needs any explanation. Fig. 3 shows the grid controlled field rectifier and its phase shifting bridge which is used to control the firing point of the tubes. When power in applied to the filament transformer primary, the a-c voltage between points 101–153 should be approximately the same as the voltage between points 152–153.

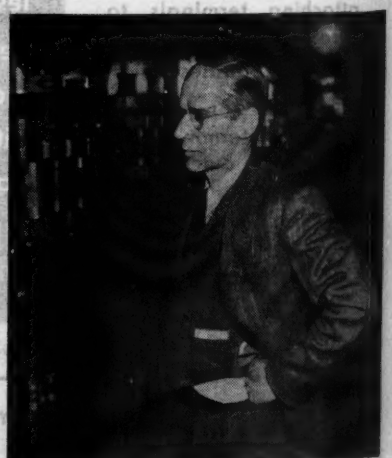
If all rectifier components have been tested, in accordance with the section on rectifiers, and found to be good, yet there is still no output voltage, the phase shift circuit may be responsible. An open timing relay contact or an open a-c winding in the saturable reactor FSX could cause this trouble. If no fault has been found thus far, the d-c winding of the saturable reactor may be to blame. If the resistance of this winding is over 5000 ohms the unit is probably defective and should be replaced.

If resistor 54R or the primary of transformer 6T (P6T) is open, or if there is no voltage at primary terminals 101, 152 or 153 on filament transformer 3T, there will be voltage output from the rectifier but it will not be controlled by the electronic control circuit.

The operation of the armature rectifier phase shifting bridge is the same as just described for the field, and is subject to the same possible troubles.

All circuit components in the armature and field rectifiers and power circuits, as well as the a-c control circuits and phase shifting bridge, are located on the main panel. The main panel wiring diagram is shown in Fig. 4.

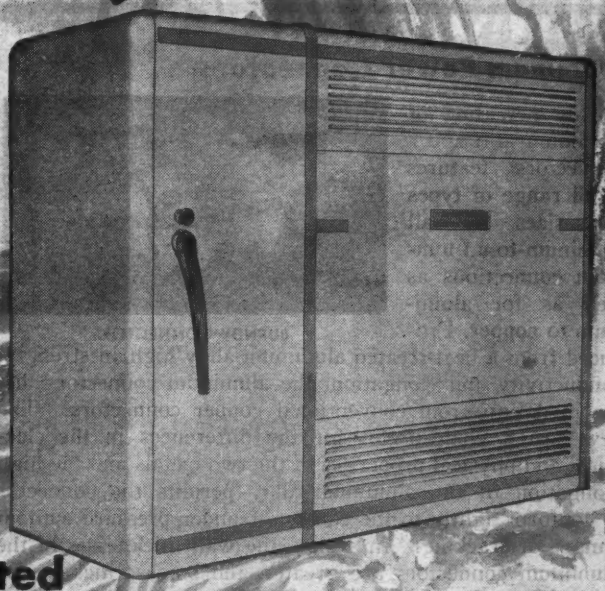
An analysis of the possible troubles that could exist in the electronic circuits which control the armature and field rectifiers will be discussed in the next article.



C. W. McKEE, manager of the General Electrical Service Company in Harrisburg, Pennsylvania, who is doing a good business in industrial maintenance to supplement his construction activity.

IT'S NOT ONLY THE HEAT . . . IT'S THE

Humidity!



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But neither of these has affected Westinghouse Air-Cooled Power Centers

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Westinghouse Air-Cooled Power Centers are dry . . . no liquids to maintain . . . no valves, no fittings. There are no gaskets to keep sealed . . . no fire-proof vault is required. All this adds up to *less* dollars for maintenance.

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For complete information, call your Westinghouse Office or write for Power Center Selector Bulletin 3224, Westinghouse Electric & Manufacturing Company, Box 868, Pittsburgh 30, Pennsylvania. J-70435

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EQUIPMENT NEWS

Aluminum Power Connectors

BURNDY CONNECTORS

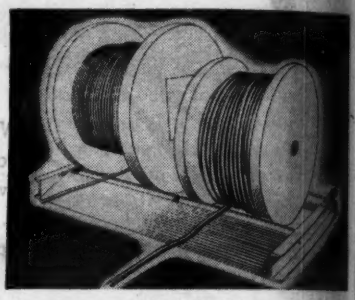
This new line of aluminum power connectors features a full range of types and sizes for all aluminum-to-aluminum connections as well as for aluminum to copper. Produced from a heat-treated aluminum alloy high in strength, conductivity and elongation, the aluminum connectors differ in design from conventional copper connectors. The new design compensates for the differences in the electrical and physical properties of the two metals and the high elongation of the aluminum alloy permits the connector to conform tightly to the conductor under pressure without danger of cracking. In design, the wall thicknesses of the aluminum connectors are greater, the bosses thicker, and radii larger, and the contact surfaces somewhat larger. Burndy Engineering Co., 107 Bruckner Blvd., New York 54, N. Y.

Illuminated Magnifiers

SCHERR MAGNIFIER

Model "C" has been added to this line of Magni-Ray illuminated magnifiers, designed to simplify and speed up visual inspection operations. It is encased in a casting made of aluminum alloy. The lens is 5 in. in diameter. The housing is fastened to the 16-in. upright rod extending from the base by means of a universal clamping device which permits swiveling both up and down and side ways. The magnifying device is supported by a triangular 12 in. by 12 in. by 12 in. cast iron base for rigidity and stability. Each unit is equipped with two 4-in. long 25-watt tubular bulbs especially silvered so that the light is reflected directly upon the work without any loss of power. It is especially designed for use on large castings for the detection of cracks, imperfections and blow holes. It is wired for use on a 110-volt current, either a-c or d-c. George Scherr Co., 200 Lafayette St., New York 12, N. Y.

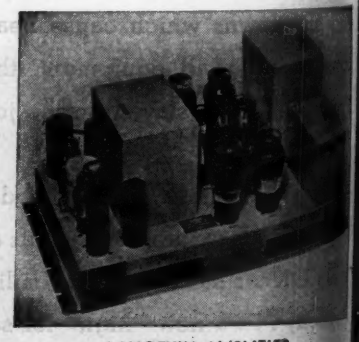
Roll-A-Reel



ROLL-A-REEL

This device, called Roll-A Reel, is a new way to handle heavy reels. It is low, and slanted front provides easy loading of reels without the use of jacks or other time-taking, troublesome methods. Sturdy ball bearing rollers unload reels with practically no effort at all. These oversized ball bearing rollers are mounted on large hardened axles to carry excessive continuous loads and provide for momentary shock when the reel is loaded. The frame is of heavy gage steel. It is light in weight and portable. It can be easily carried to reel location in storage or on the job. It is designed to roll reels of electrical wires or cables, steel strand and rope. Style A has a capacity of 2000 lbs. and supports up to one 27-in. wide reel. Style B has a capacity of 4000 lb. and supports two 24-in. wide reels or one 48-inch wide reel. Roll-A-Reel, 327 W. Fourth St., Cincinnati 2, Ohio.

Amplifier



LANGEVIN AMPLIFIER

A series of amplifiers known as the 101 type has just been announced. These amplifiers are designed for commercial continuous service, and meet the need for medium gain, high power bridging amplifiers. Where increased power is desired any number may be bridged across buses from 1 to 1000 ohms. A complete amplification system is provided when used in conjunction with a program or line amplifier such as the Langevin 102 series. All models in the 101 series will deliver 50 watts to a nominal load impedance with less than 3 percent RMS harmonic distortion at 400 cycles. The gain control provides continuous adjustment over a 40 DB range and bridging connections. The Langevin Co., 37 W. 65th St., New York, N. Y.

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3. BOLT securely with a turn of the wrench.

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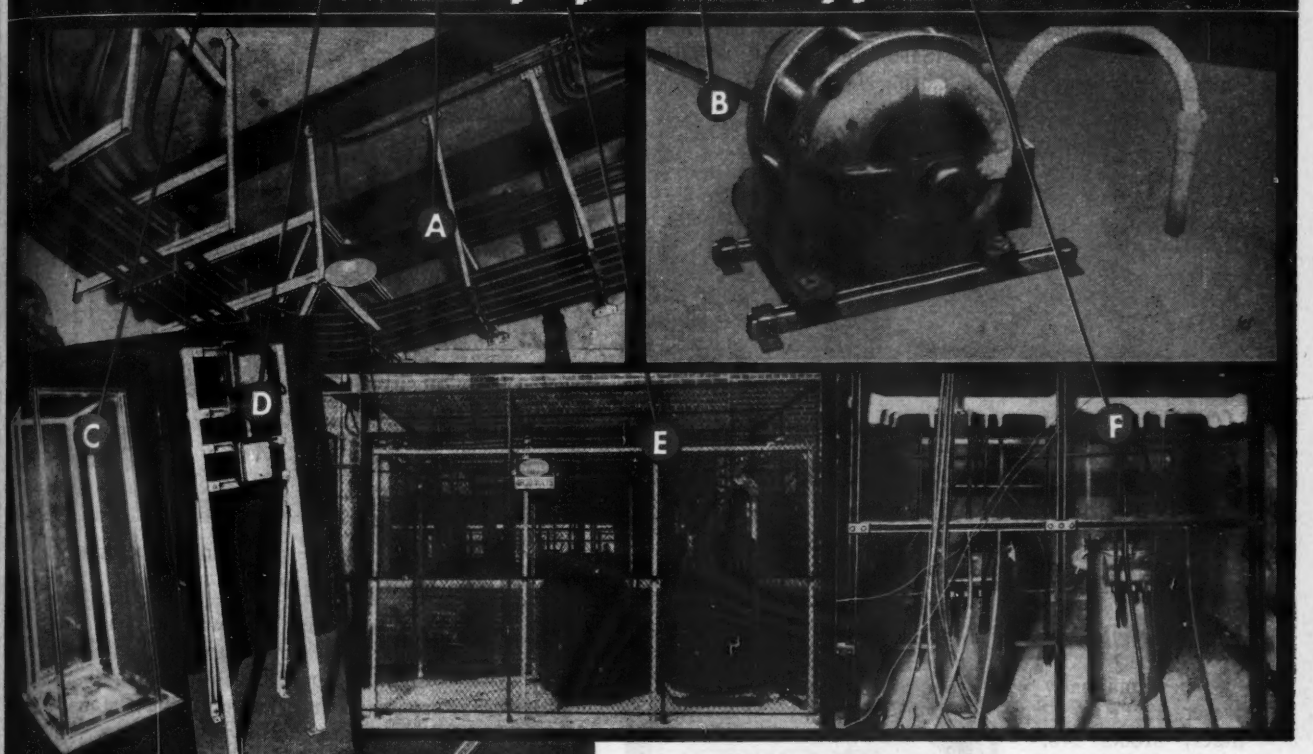

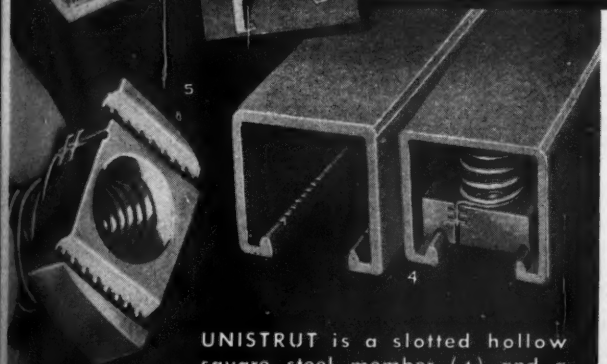

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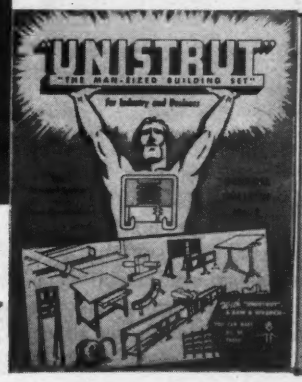

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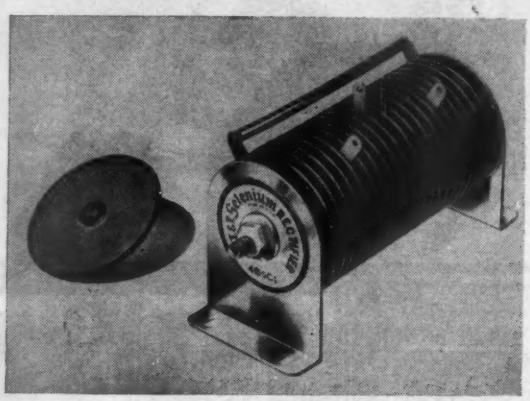
Center Contact, a patented plate construction in metal-plate rectifiers which allows complete coating protection against destructive atmospheres, is available in new units. This type of construction permits a new method of applying protective coatings to metal-plate rectifiers. Where the standard petal contact is sprayed with a protective coating, Center Contact is especially adapted to the application of a heavier and better coating to protect the rectifier from fungus-bearing, salt spray laden or corrosive atmosphere. This power supply equipment has a wide application in the fields of radio, communications, aviation, electronics, railway signalling and wherever direct current is required from an a-c source. The Center Contact construction is available in the same ranges of sizes and capacities as the standard petal-type contact. Selenium Rectifier Products, Federal Telephone & Radio Corp., Newark 1, N. J.



FEDERAL RECTIFIER

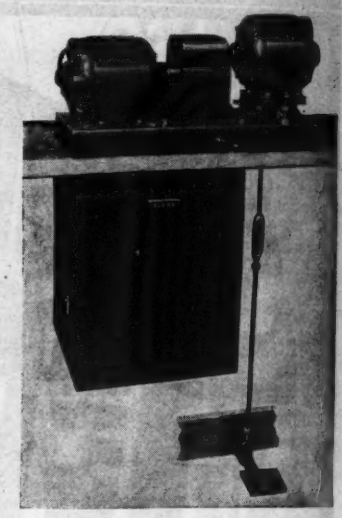
Industrial Timer

A new manually preset interval timer, Model No. 2500 has been announced. It can be preset to allow a given operation to continue for almost any predetermined time limit, and to close or open a circuit at the end of the preset time. The unit is adapted for use in plastic molding rubber curving, batch mixing, heat treating, enamel baking, liquid agitation, light exposure, blower, pump and conveyor operations, power and light disconnect, machinery operation, control of ventilating fans on a preset schedule and night heating shutdown. Some of the features are single pole, double throw, 1,000-watt capacity, fully enclosed switch; two exposed gears; self-starting, slow speed, industrial type synchronous, completely sealed motor; no energy is required of clock motor to trip switch at end of preset time; ten time ranges from 0 to 15 seconds through 0 to 20 hours; and all parts rust proofed and protected against corrosion. The 2500 series can be mounted to the surface of any panel or directly to the surface of the equipment the timer is to control. It is also designed to be mounted directly over and to any standard single gang switch box or handy box. Available for flush mounting or wall mounting with conduit connector. Overall dimensions are 4⅞ in. high by 3⅞ in. wide by 2 in. deep. Paragon Electric Co., 37 W. Van Buren St., Chicago 5, Ill.

PARAGON TIMERS

Wire Stripper

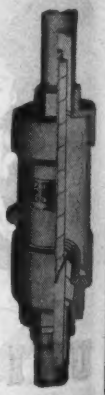
A new wire stripper for cleaning cotton and enamel, silk and enamel, string asbestos and similar types of light insulation, is announced. Round, flat or rectangular wire, solid or stranded, may be stripped. It is especially suited for cleaning fine "Litz", "Formex", "Formvar" wire and fiber glass insulation. Two wire cleaning brushes are positively driven, being mounted directly on the end of separate motor shafts. The right hand motor is mounted on a pivoted base and is normally held up by a spring. This keeps the brushes apart, except when stripping wire. To strip wire, insert the wire in the opening and press the foot pedal. This brings the upper brush down against the wire and the lower brush. Where desirable, the distance between the brushes may be set to the diameter of wire, thus eliminating the foot pedal action. The strippings, dust and dirt, are removed by a dust collector. This is driven by a separate motor, has a dust capacity of 1 cu. ft. per min. and is rated at 60 cu. ft. of air per min. at a 0.55 in. static pressure. Ideal Commutator Dresser Co., 1041 Park Ave., Sycamore, Ill.



IDEAL WIRE STRIPPER

Terminator

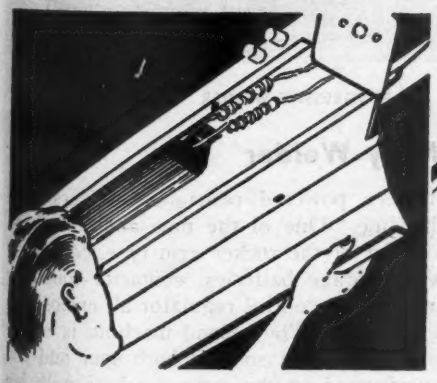
This Type "J" terminator is designed for use either as a terminator and sealing fitting or as a pulling or splicing chamber. It permits sealing and terminating conduits and cables outside of chambers without disturbing electrical installations. When installed with cabinets, the conduit work is terminated at the proper height below the box. The device is dismantled and properly assembled on the end of the conduit, then tied into the box with a chase nipple that is furnished with the fitting. The oversize sleeve is of sufficient dimensions to provide ample room for pulling-in belling, splicing and other processes. The terminator is made in sizes to accommodate conduit from 1 in. to 4 in. O. Z. Electrical Manufacturing Co., 215 Bond St., Brooklyn 2, N. Y.



O. Z. TERMINATOR

ALL METAL FLUORESCENT INDUSTRIAL

LIGHTING PRODUCTS INC.
ONE MAN INSTALLATION



Hinged Reflector simplifies fixture hanging to one man where the ordinary fixture requires two. The housing which contains all electrical equipment, is first hung in the desired position. Reflector is then hooked on housing as shown in above illustration. This relieves person of holding up the entire weight of Metal Reflector. When units are mounted in continuous runs any unit Reflector may be swung independently of the others.

With Labor Saving Installation and Maintenance Features . . .

Engineered and manufactured to more than meet the most rigid lighting specifications, the new all-metal-all-feature No. 125-A with conventional type ballasts and the No. 130-A furnished with instant start ballasts, combine design features not to be found in any other industrial fluorescent fixture.

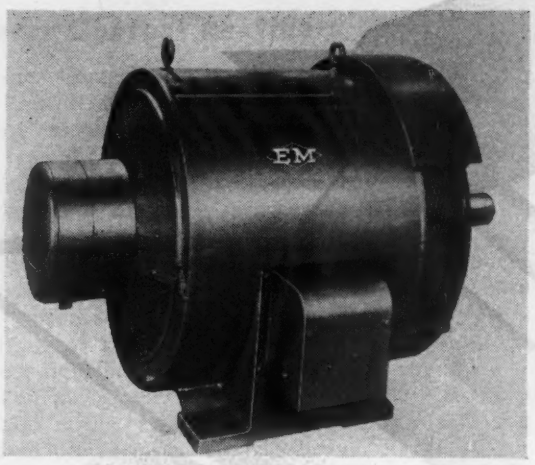
Not only are these units outstanding in utility design—but are constructed to give longer life and to deliver more high intensity effective illumination to the lighting plane.

Following are the features that makes these leading luminaires—

Patented "One Man Installation" — Designed for any type of hanging, including continuous runs—Metal drop ends for socket protection — Separate starters on conventional type units — Third lamp may be added later on two lamp units—Knockouts in ends for pull change switches—Twice fired baked enamel reflectors—All units die formed and electrically welded—Underwriters approved.

The Instant Start Series No. 130-A can be operated on uneven voltages and at low temperatures. This type of fixture requires no starters and turns on and off like an incandescent fixture. Its transformer is guaranteed for a full year against defects.

LIGHTING PRODUCTS, INC.
HIGHLAND PARK • ILLINOIS

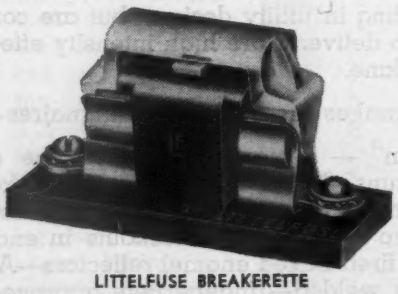


E-M GENERATORS

Generators

A new line of high speed a-c generators has been announced. Built in sizes 18.7 to 125 kva. 1800 to 514 rpm, for standard voltages, 1, 2 and 3 phase, 50 and 60 cycles, these generators are supplied as two-bearing units for belted or coupled duty, or single-bearing for direct coupling to driving engine. They are also available as packaged units, with controls mounted on generator frame, and wiring factory-connected. Packaged controls consist of a NEMA Class 1 metal enclosure, housing the E-M Synchrostat voltage regulator and meters. Ventilating air of generator is supplied by E-M "Pol-Aire" ventilating system. A suction-type fan at the drive end of the generator pulls a large volume of ventilating air through both the direct-connected exciter and the generator. The intake of ventilating air is at the exciter end, opposite the driving engine on direct-coupled units, preventing circulation of heated air. Standard direct-connected exciter is of quill type, mounted on an extension of the generator shaft, compact, and of drip-proof construction. Top-mounted exciters with protected V-belt drive are furnished on certain speed ratings below 1200 rpm. Electric Machinery Mfg. Co., Minneapolis 13, Minn.

Circuit Breaker



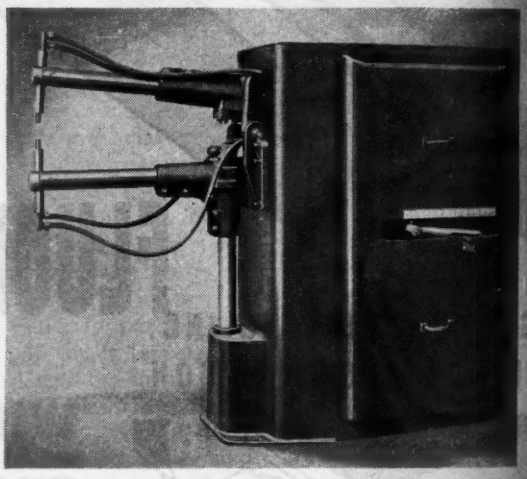
LITTELFUSE BREAKERETTE

Reset protection in circuit breaker form interchangeable with all 5 AG fuses or Navy midget size, both for new equipment and replacement, is now available in the new Breakerette. It is of the push breaker type, rated at 32 volts a-c or d-c. Break is snap action capable of interrupting short circuits of 1000 amp. in ratings up to 5 amp. and 2500 amp. in ratings over 5 amp. capacity. Time characteristics of the fuses are duplicated electrically. It is provided with 5 AG caps to fit into standard 5 AG fuse clips and can be used wherever 5 AG fuses are employed —in commercial airlines, buses and trucks, automotive field, railway signal systems. Both trip-free and non-trip free features are provided. Littelfuse Incorporated, 4757 Ravenswood Ave., Chicago 40, Ill.

Lug Kit

AIRCRAFT MARINE KIT

Now available to industry for general solderless wiring is a new complete electrical wiring kit. The kit comprises a 6-purpose precision installation tool which cuts and strips the wire, indicates stud sizes and crimps terminals to the wire. Also included in the kit is an assortment of 100 amp. solderless terminals of the most commonly used types. No soldering is required to make trouble-free electrical connections. Merely insert wire in terminal barrel and crimp with tool. Aircraft-Marine Products, Inc., 1593 North Fourth St., Harrisburg, Pa.



PROGRESSIVE WELDER

Storage-Battery Welder

Two storage-battery powered resistance welders have been added to this line. One of the new additions is an "economy" spot-welder of the rocker arm type, completely self-contained, with storage batteries, contactor-controller and infinitely variable heat-control regulator all enclosed in the base of this machine. The second machine is of the heavy duty type and designed so that both spot and roll welding can be performed on the same machine with but minor changes. Batteries for this type of machine are housed with contactors, battery chargers and controllers in standardized power-pack units. A feature of both types of machine is that complete battery assemblies can be removed as a unit for servicing or replacement when necessary with only simple electrical and cooling water lines to disconnect. Operation of the economy model is from normal factory air line pressure. The electrical system consists of six 3-cell welding batteries specially designed to withstand high discharge rates. It has a throat depth of 24 in. Both upper and lower arms are adjustable. Rated capacity of the machine is two pieces of 14 gage mild steel or two thicknesses of 0.040 in. aluminum. Control for the stepless wide range sliding contact type heat regulator is on the side of the base. Electrodes of the welder are designed so that either water or refrigerated cooling may be employed. Progressive Welder Co., 3050 E. Outer Drive, Detroit 12, Mich.

MASTER GEARHEAD MOTORS

COST REDUCED by the elimination of bearings, couplings, chains, and sprockets, gear trains or separate gear reducers . . . only one unit to mount . . . lower assembly costs.

COMPACT. High reduction ratios secured in small space by using heat treated special alloy steels for both splined shafts and gears.

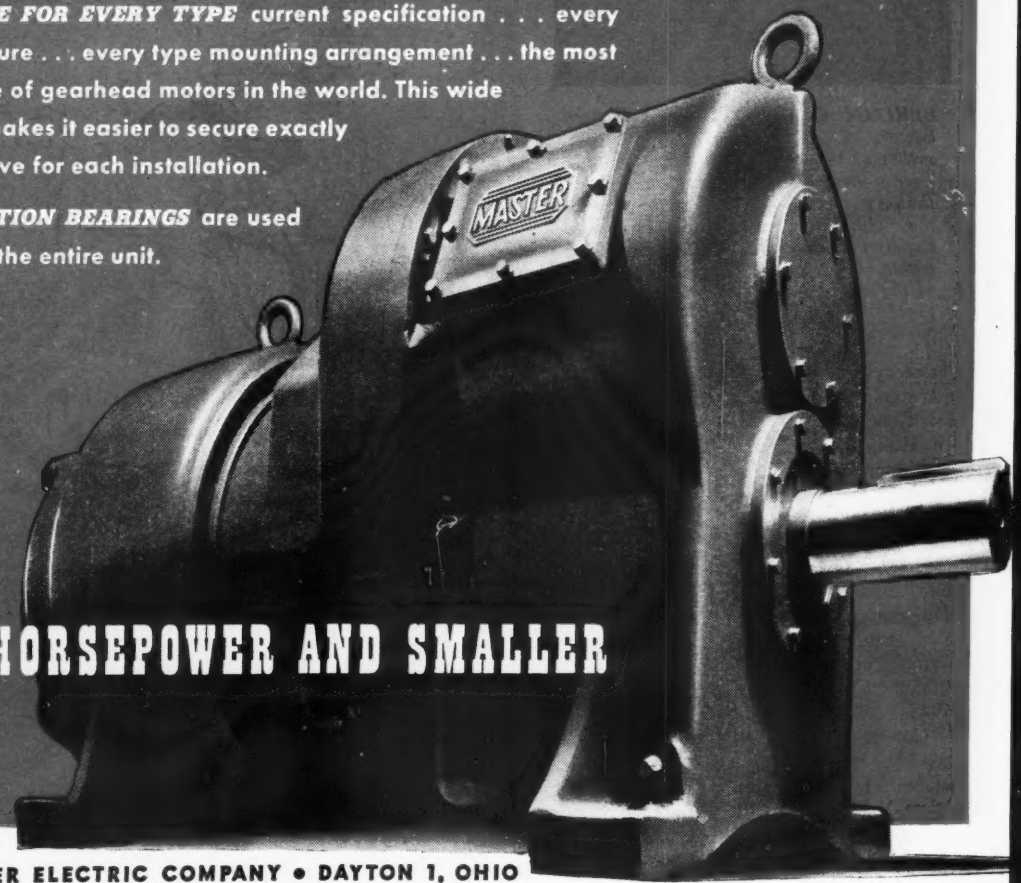
HIGHER EFFICIENCY than other types of slow speed drives . . . only 2 percent power loss in each stage of gear reduction, in parallel shaft types.

SIMPLIFIED DESIGN. More compact . . . less weight . . . permanent alignment . . . fewer moving parts . . . high efficiency . . . longer, reliable, trouble-free operation.

INTEGRAL CONSTRUCTION. Both motors and gears are designed, built, and guaranteed by one organization as a well balanced power package.

AVAILABLE FOR EVERY TYPE current specification . . . every type enclosure . . . every type mounting arrangement . . . the most flexible line of gearhead motors in the world. This wide flexibility makes it easier to secure exactly the right drive for each installation.

ANTI-FRICTION BEARINGS are used throughout the entire unit.



100 HORSEPOWER AND SMALLER

THE MASTER ELECTRIC COMPANY • DAYTON 1, OHIO

IN THE NEWS

MEET BERLON COOPER

Our new Eastern editor, whose name appears on the masthead of this issue for the first time, is Berlon C. Cooper. He hails originally from Chatham County, North Carolina, took his early schooling in Siler City and his B.S. in Electrical Engineering at the University of North Carolina in 1925.

An early interest in lighting took him to Chicago with Curtis Lighting, Inc., and from this to Baltimore as a sales engineer. In 1931 he started travelling the

BERLON C. COOPER, new Eastern Editor of Electrical Contracting, is author of the series of articles, "Lighting Techniques" which started in the January issue. He took his E.E. at the University of North Carolina. Experience with manufacturers and distributors and contact with all branches of the industry has brought him in close touch with industry technology and practices.

territory from Pennsylvania to North Carolina as Lamp and Lighting Specialist for General Electric Supply Corporation. In 1932, he became Associate Electrical Engineer in the Mechanical Engineering Section of the Public Building Administration, Federal Works Agency in Washington, where he prepared lighting equipment details and specifications for many of our most prominent Federal buildings. He joined the Lighting and Fixtures Section, Building Materials Division of the War Production Board in early 1942 and became Chief of the Section in January, 1943.

Cooper's editorial journeys will extend over the East and East Central states. He will make his headquarters in New York. You'll be seeing him around.

I. E. S. TO EXPAND RESEARCH FACILITIES

Numerous steps are being taken to expand the research facilities of the Illuminating Engineering Society—to advance its status as a fact-finding organization, S. B. Williams, president of I.E.S., and editor of *Electrical World*, told 150 members of the Chicago section, I.E.S., at their January 5 meeting.

To achieve this goal, the Society plans to: (1) Establish a fund for research in lighting and seeing problems; (2) compile better recommended practices; (3) guide the development of better lighting equipment; (4) study and investigate quantity and quality of light; (5) promote formal illumination courses at colleges and universities and (6) prepare a lighting handbook.

The lighting industry's task in the next ten years is to relight America, Mr. Williams asserted, but cautioned that this should not be construed merely as a means of selling more lamps, fixtures and kilowatt hours. Rather, the industry should strive to serve the public better and, by so doing, advance as a profession.

Illuminating engineering is advancing at a slow pace to the status of a profession, but we still have a long way to go, he stated, adding that engineering is an exact subject and at present we have too few facts to go on. We must test the information developed in the research laboratory and it is the function of the I.E.S. to provide the fundamental knowledge that is applied by the lighting industry, Mr. Williams concluded.

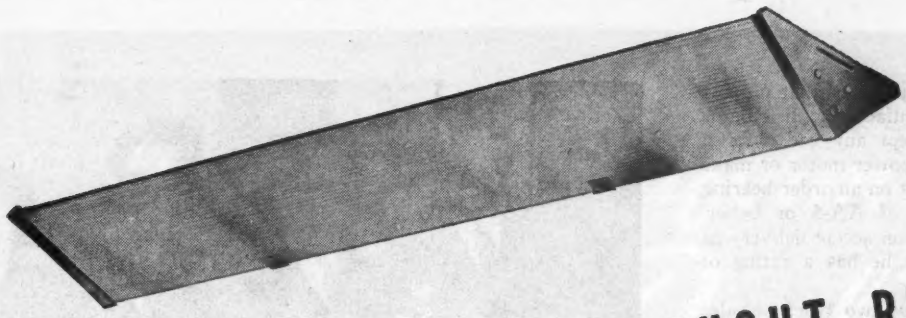
FRACTIONAL HORSEPOWER MOTOR SALES

The War Production Board has issued an explanation of controls over the sale of new fractional horsepower motors below one horsepower. This explanation was believed advisable because such motors are in short supply and because many persons apparently do not understand the restrictions regarding their sale, WPB said.

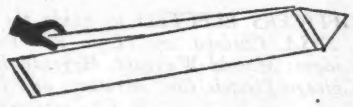
A certain number of fractional horsepower motors are being allocated each month for civilian and commercial replacement purposes. It is important to the war effort that these be sold and delivered strictly in accordance with prescribed regulations, WPB said.

Order L-123 controls the distribution

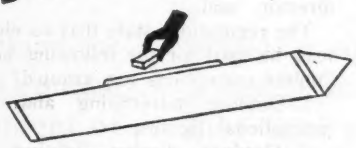
"I don't know why you can't do this! My girdle is killing me!"



LAMPS CAN BE REPLACED WITHOUT REMOVING GLASSWARE



. . . . . BALLASTS, STARTERS REMOVABLE WITHOUT DISTURBING OTHER PARTS



GLASS PANELS REMOVABLE FOR CLEANING WITHOUT TOOLS

WESTINGHOUSE COMMERCIAL FLUORESCENT LUMINAIRES

ARE EASY TO MAINTAIN

New improved Westinghouse fluorescent luminaires are the answer to a maintenance man's dream—no "teardowns" every time a little replacement or cleaning is needed—no tight squeezes to replace starters or ballasts. And that's not all . . . four styles are available for individual or continuous strip installation . . . for suspension or ceiling mounting. Any style can be mounted and arranged to provide just the right level of cool, glareless lighting required for any office, drafting room . . . or similar application.

You'll be pleasantly surprised at the noticeable improvement in room appearance . . . and worker efficiency that results from lighting with new Westinghouse fluorescent luminaires. Get full details from your Westinghouse distributor today. Or write for B-3332. Westinghouse Electric & Mfg. Co., Dept. 7-N., East Pittsburgh, Pa.

J-04011

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Lighting Equipment

of these motors. It provides that no person, including a manufacturer, distributor or dealer, shall accept any order for a new fractional horsepower motor or make delivery of one except on an order bearing a preference rating of AA-5 or better. Neither can any person accept delivery of such a motor unless he has a rating of AA-5 or better.

There are, however, two types of sales that do not require ratings. One is the sale on a farmer's certificate of purchase provided for in Priorities Regulation No. 19. The other is delivery of a new motor to a householder or other user for replacement of a damaged motor, and the seller, in accordance with his regular business practice, takes the damaged motor in return and repairs it, or delivers it for repair to another person, so that it will be available for resale. When repair is not practicable, however, the damaged motor may be scrapped. A dealer or repairman may also turn in a damaged motor to a manufacturer or other supplier and receive in exchange a new or rebuilt motor without a rated order.

If a motor is delivered without a properly rated order or without meeting either of the qualifying provisions outlined, both the seller and the purchaser are in violation of the order and are subject to the prescribed penalties.

Motor manufacturers, distributors, dealers, mail order firms, repair shops, and all other sellers of new fractional horsepower motors must familiarize themselves with the provisions of Order L-123, WPB officials emphasized.

NEW OFFICERS ELECTED to guide the activities of the Central District Chapter, NISA, Chicago, are (L to R): Paul Martin, Northwestern Electric Co., president; Harold Weygant, Hygrade Electric Co., vice-president; Robert Kaska, Chicago Electric Co., secretary; and James J. Smat, Queen City Electric Co., treasurer.

SOME USES OF ELECTRICITY PROHIBITED TO CONSERVE COAL

Theatre and hotel marquees and all outdoor signs and illumination were eliminated effective February 1 throughout the nation to conserve coal and oil for essential war use by the War Production Board.

The new regulations are expected to save 2,000,000 tons of coal annually and halt the necessity of drawing on fast dwindling stockpiles, J. A. Krug, WPB director, said.

The regulations state that no electricity may be used for the following purposes, "unless exemptions are granted":

1. Outdoor advertising and outdoor promotional lighting.
2. Outdoor display lighting, except where necessary for the conduct of the business of outdoor establishments.
3. Outdoor decorative and outdoor ornamental lighting.
4. Show-window lighting, except where necessary for interior illuminations.
5. Marquee lighting in excess of 60 watts for each marquee.
6. White-way street lighting in excess of the amount determined by local public authority to be necessary for public safety.
7. Outdoor sign lighting except for:

(A) Directional or identification signs required for fire and police protection, traffic control, transportation terminals or hospitals; or directional or identification signs for any similar essential public service the lighting of which is specifically certified to be necessary by local public authority. Certification shall be made in writing to the electric supplier.

(B) Directional or identification signs using not more than 60 watts per establishment, for doctors and for hotels, and for other public lodging establishments.

Penalties for non-compliance will be invoked by the Office of War Utilities, a branch of the WPB and will include discontinuance of electric service to consumers found guilty of willful violations, Mr. Krug said.

The only areas exempt from the rule are localities which receive their electricity from hydro-electric plants instead of from coal-burning generating plants. Any electric supplier who feels that compliance with the order will not reduce the consumption of coal or other scarce fuels may apply to the WPB for such an exemption, Mr. Krug said.

The order was drafted by the Office of War Utilities after a series of conferences with representatives of electrical industries throughout the nation.

In addition to electric lighting covered by the regulation, the WPB also appealed for a maximum effort of voluntary power conservation and for greater economy of electric lighting. Mr. Krug said that the "electric industry of the nation both public and private had pledged its whole-hearted co-operation in support of the fuel conservation program."

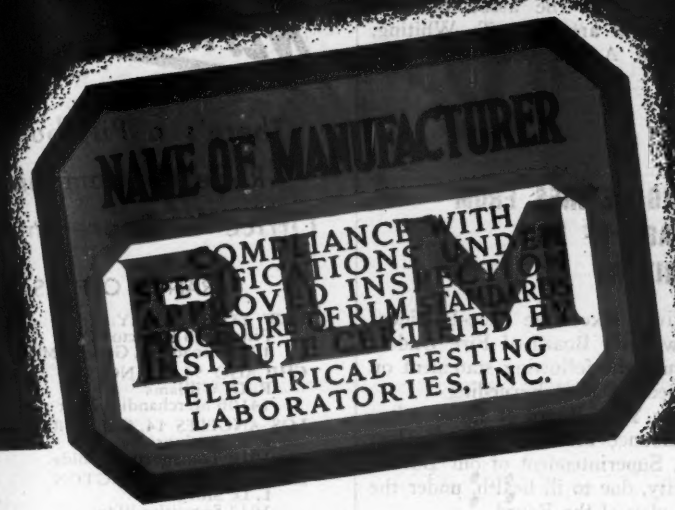
I.E.S. EXECUTIVES at recent meeting of the Chicago Section were: (L to R) L. V. James, Chicago, regional vice-president; J. A. Harrington, secretary of Chicago Section; S. B. Williams, New York, president; David B. Wood, vice-president of Chicago Section; and E. E. Elliot, chairman of the Chicago Section. Addressing the meeting, president Williams outlined the I.E.S. plans to increase its fact-finding facilities.

REACE HEADS CHICAGO ELECTRIC ASSOCIATION

William T. Reace, vice-president in charge of sales for Commonwealth Edison Company, was elected president of the Electric Association of Chicago, at a

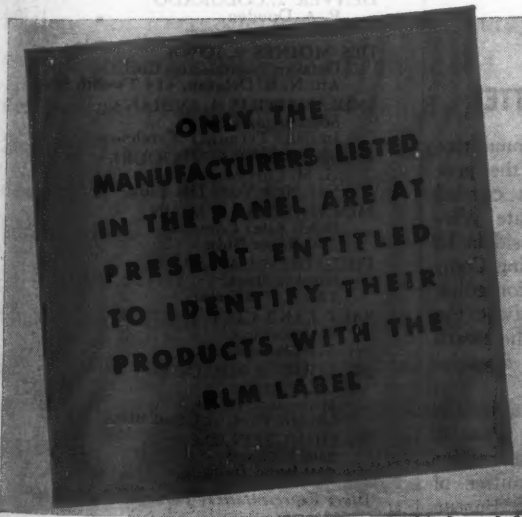
THE CERTIFICATE OF *Uniform Quality*

IN INDUSTRIAL LIGHTING FIXTURES



The guiding motive behind the founding of the RLM Standards Institute was the consistent improvement of industrial lighting equipment and practice...to secure the widest possible understanding of the advantages of scientifically engineered industrial lighting equipment . . . to provide exacting specifications for such equipment . . . to provide a rigid testing and inspection procedure so that every unit bearing the RLM label of certification will be instantly recognized as conforming to the RLM specifications.

Copies of all RLM specifications may be secured from these manufacturers, or direct from RLM Standards Institute.



RLM—CERTIFIED TYPES

Manufacturer	Fluorescent Luminaires			Incandescent Lamp Reflectors		
	2-40	3-40	2-100	Dome	Bowl	Angle
ABOLITE				X		
BENJAMIN	X	X	X	X	X	X
BRIGHT LIGHT	X	X	X	X		
DAY-BRITE	X	X	X			
GOODRICH				X	X	X
MILLER	X	X	X	X		
QUADRANGLE				X	X	X
OVERBAGH & AYRES				X	X	X
SMOOT-HOLMAN	X	X	X	X	X	X
WESTINGHOUSE	X	X	X	X	X	X
WHEELER	X	X	X	X	X	X

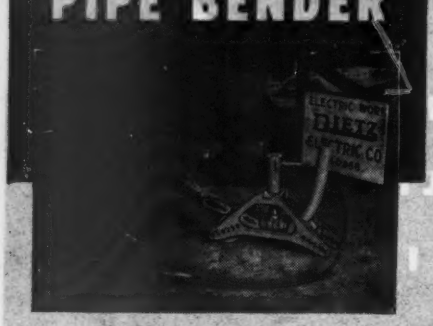
The Letters RLM Stand for Reflector and Lighting Equipment Manufactures

RLM STANDARDS INSTITUTE
INCORPORATED
307 N. MICHIGAN AVENUE • SUITE 420 • CHICAGO 1, ILLINOIS

YOU GET ALL THREE

with a

BLACKHAWK PIPE BENDER



Blackhawk Benders do MORE than bend pipe. They include a Porto-Power Hydraulic Unit that can be used separately from the bending attachments. Here is the triple utility:

1 PIPE BENDING

Smooth, remotely controlled hydraulic power bends rigid conduit and pipe up to 4" diameter. Saves need for elbows and couplings and otherwise necessary cutting and threading.

2 MAINTENANCE and PRODUCTION

Big range of attachments adapt the hydraulic unit to push, pull, bend, press, spread and clamp work. Pull gears and pulleys, lift machinery, remove bushings—do scores of other jobs allied to pipe bending.

3 SPECIAL JACK

Compact 10 or 20-ton ram (same as used in pipe bending) works in all directions — and at any angle. Preferred to all other types of jacks.

MAIL COUPON TODAY

BLACKHAWK MFG. COMPANY
Dept. P2035, Milwaukee 1, Wis.

Send Full Information on your Pipe Benders.

Name.....

Company.....

Address.....

recent meeting. He succeeds C. J. Maloney, district manager of Cutler-Hammer, Inc.

Mr. Reace, a veteran of 28 years of service with Commonwealth Edison Company has been a director of the Electric Association since 1943. Starting his utility career in 1916 as a sign salesman he became manager of merchandise sales in 1936 and was elected vice-president in 1943.

Other officers of the association re-elected for 1945 are Fred T. Whiting, treasurer, and A. A. Gray, secretary-manager.

FERNEDING RETIRES FROM N. Y. BOARD OF FIRE UNDERWRITERS

E. C. Niver, Executive Vice-President of the New York Board of Fire Underwriters issued the following statement on the retirement of Paul Ferneding.

"The New York Board of Fire Underwriters announce the retirement of Paul Ferneding, Superintendent of our Bureau of Electricity, due to ill health, under the retirement plan of the Board.

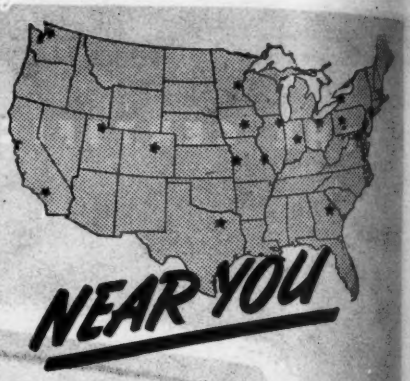
"Mr. Ferneding has served the fire insurance companies and the electrical industry with distinction since 1922 and has been Superintendent of our Bureau of Electricity since 1934. In addition to the valuable service rendered to us by Mr. Ferneding as an able executive and administrator, he has served as a member of many important committees in the electrical and insurance industry.

"We greatly regret that necessity requires the termination of his active association and leadership with us at this time."

NEMA APPOINTS ADEQUATE WIRING COMMITTEE

The importance of having a Committee of NEMA members to review the progress made under the program carried forward by the National Adequate Wiring Bureau has decided the President to appoint a NEMA Adequate Wiring Committee. In addition to the foregoing function, this Committee will advise the NEMA Budget Committee and the Board of Governors regarding the financial needs of the N.A.W.B.

The chairman of this new Committee is V. R. Despard, vice president, Pass & Seymour, Inc., who has been an active member of the Executive Committee of the National Adequate Wiring Bureau for several years. Other members invited to serve on the Committee are: C. W. Higbee, manager, Wire and Cable Department, United States Rubber Co.; W. M. McCauley, vice president, Railway & Industrial Engineering Co.; D. J. Murray, sales manager, Conduit Product Sales, General Electric Co.; T. J. Newcomb, sales manager, Electric Appliance



NEAR YOU

There's a Pittsburgh Reflector Company Office or Representative

BRANCH OFFICES

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Pittsburgh Reflector Co.
1775 Broadway, General Motors Bldg.

CHICAGO 54, ILLINOIS
R. O. Williams
14106 Merchandise Mart

LOS ANGELES 14, CALIFORNIA
F. E. Hastings
1010 Transportation Bldg.

SEATTLE 1, WASHINGTON
L. D. Morgan
1012 Securities Bldg.

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Bona Allen Bldg.

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BROOKLINE 46, MASS.
Detweiler-Bell Co.,
60 Dwight Street

BUFFALO 3, NEW YORK
H. H. Mallon
368 Elm Street

CLEVELAND, OHIO
Handel-Davies Co.
112 Chester Avenue

DALLAS 2, TEXAS
George E. Anderson Co.
Santa Fe Building

DENVER 2, COLORADO
P. A. Douden
1645 Wazee Street

DES MOINES 9, IOWA
Delavan Engineering Co.
Att: N. B. Delavan, 414 Twelfth Street

INDIANAPOLIS 4, INDIANA
Scott-Jaqua Co.
Indiana Terminal Warehouse

KANSAS CITY 6, MISSOURI
H. M. Curfman
946 New York Life Bldg.

MINNEAPOLIS 2, MINN.
Balch Sales Company
200 Baker Bldg.

PHILADELPHIA 6, PA.
Hopkin Bros.
120 N. 7th Street

SALT LAKE CITY 1, UTAH
R. Ackerman
318 Dooly Block

ST. LOUIS 8, MISSOURI
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Lindale Blvd. at Grant Blvd.

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410 Bond Building

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PITTSBURGH REFLECTOR COMPANY
OLIVER BUILDING • PITTSBURGH

MFRS. OF PERMAFLECTOR LIGHTING EQUIPMENT

Pittsburgh Permaflector Fluorescent Luminaires

combine

Good Lighting with Good Taste

This shielded type 4-40 watt Fluorescent Luminaire typifies the combination of engineered lighting with beauty of design. Light is controlled, maintenance made easy; mounting is flexible—may be individual, continuous, direct ceiling or suspension.

CROSS SECTION

THIRTY-THREE years of experience manufacturing *engineered* lighting equipment assures the maximum efficiency of *Permaflector Fluorescent* Luminaires.

And something *else* has been added . . . *good taste* . . . design that is functional yet beautiful in its simplicity and dignity. The same qualities of restraint that mark good design, whether in decoration or architecture, are inherent to the Pittsburgh Fluorescent line.

Permaflector engineers have built into these new Fluorescent Luminaires features that make installation and maintenance easier. Full technical information regarding these new Fluorescent Luminaires or the complete line of Permaflector Incandescent Equipment is yours for the asking.

7 Points of Positive Superiority

1. Light distribution controlled by reflector. Reflector removable for access to wiring channel.
2. Hanger provided with fittings that prevent unit from swinging out of alignment.
3. Lamp holders securely mounted in separate mounting strap.
4. New types of iridescent glass panels full length of unit—easily removable for maintenance.
5. Metal strip rigidly supports glass panels.
6. Contrasting glass panels add to beauty of design.
7. Reinforcing steel plate.

Pittsburgh Reflector Company

OLIVER BUILDING · PITTSBURGH, PA.

★Manufacturers of Permaflector Lighting Equipment, distributed by recognized electrical wholesalers everywhere.

Representatives in Principal Cities

OHIO CARBON BRUSH AIDS

designed to fit your requirements!

CARBON BRUSHES ...Carbon brushes in simple language are contact pieces of conducting material which provide transmission of electric current between stationary and rotating parts of electric machines which either generate or utilize electric energy for power. Though they are a small and comparatively inexpensive part, they perform a most important function.

MOTORS... GENERATORS ...Correct brush application helps eliminate such things as sparking—noise—over-heating—commutator discoloration and wear; any one of which results in inefficient machine operation.

THE ENGINEER ...in your plant realizes that motor efficiency can be greatly impaired by the use of incorrect brush applications. Therefore, he is the strongest exponent of correct selectivity in the specification of carbon brushes.

SPECIALLY DESIGNED BRUSHES ...special design is necessary in the creation of carbon brushes for the simple reason that the average motor is manufactured to operate under certain specific conditions. In actual operation it may be found that atmospheric or temperature conditions, to mention a few, greatly affect motor efficiency. In such cases it becomes necessary to create a specially designed product.

THE PURCHASING AGENT... usually finds it necessary to specify brushes for a great variety of motors. He ordinarily must buy from many sources. Hence, our organization has instituted a controlled index charting system which is designed to facilitate the correct brush purchases from a single source.

OHIO CHARTING SERVICE our engineering department is capably staffed to make a survey of all motors in your plant, and to recommend the proper brushes to be used in each case and compile all technical data into book form for your reference. There is no charge for this service. It will be your guide to efficient motor operation and increased production.

Are you one of the many who have availed themselves of this Service? If not, write today for more detailed information.

CARBON BRUSHES *designed to fit your* REQUIREMENTS

THE OHIO CARBON COMPANY

12508 BEREA ROAD • CLEVELAND 11, OHIO

Division, Westinghouse Electric & Mfg. Company; J. A. Rodgers, vice president, White-Rodgers Electric Co.; E. O. Shreve, vice president, General Electric Co.; R. T. Stafford, manager, Transformer Division, Allis-Chalmers Mfg. Co.; G. C. Thomas, Jr., president, The Thomas & Betts Co.

All NEMA members have been provided with a printed report covering (a) the 1944 wiring activity accomplishments; (b) the program approved for 1945 and (c) an outline of an expanded program to be undertaken when the European phase of the war is concluded.

WMC ISSUE REVISED LABOR MARKET AREA CLASSIFICATIONS

Increased labor demands as a result of stepped-up war production are reflected in the War Manpower Commission's revised labor market area classification effective January 1, 1945, WMC has announced.

Four areas, one of them heretofore unclassified, were added to the Group I classification, areas of acute labor shortages, bringing the total for January to 72 as against 68 in December.

The additions to Group I are Minneapolis-St Paul, Minn.; Norristown, N. J.; Paterson, N. J., and Borger, Texas. The Texas city had not previously been classified, but the others had been in Group II.

Five other areas were moved up from Group III to Group II. These are Amarillo, Texas; Denver and Pueblo, Colo, and Eau Claire and Kenosha, Wis.

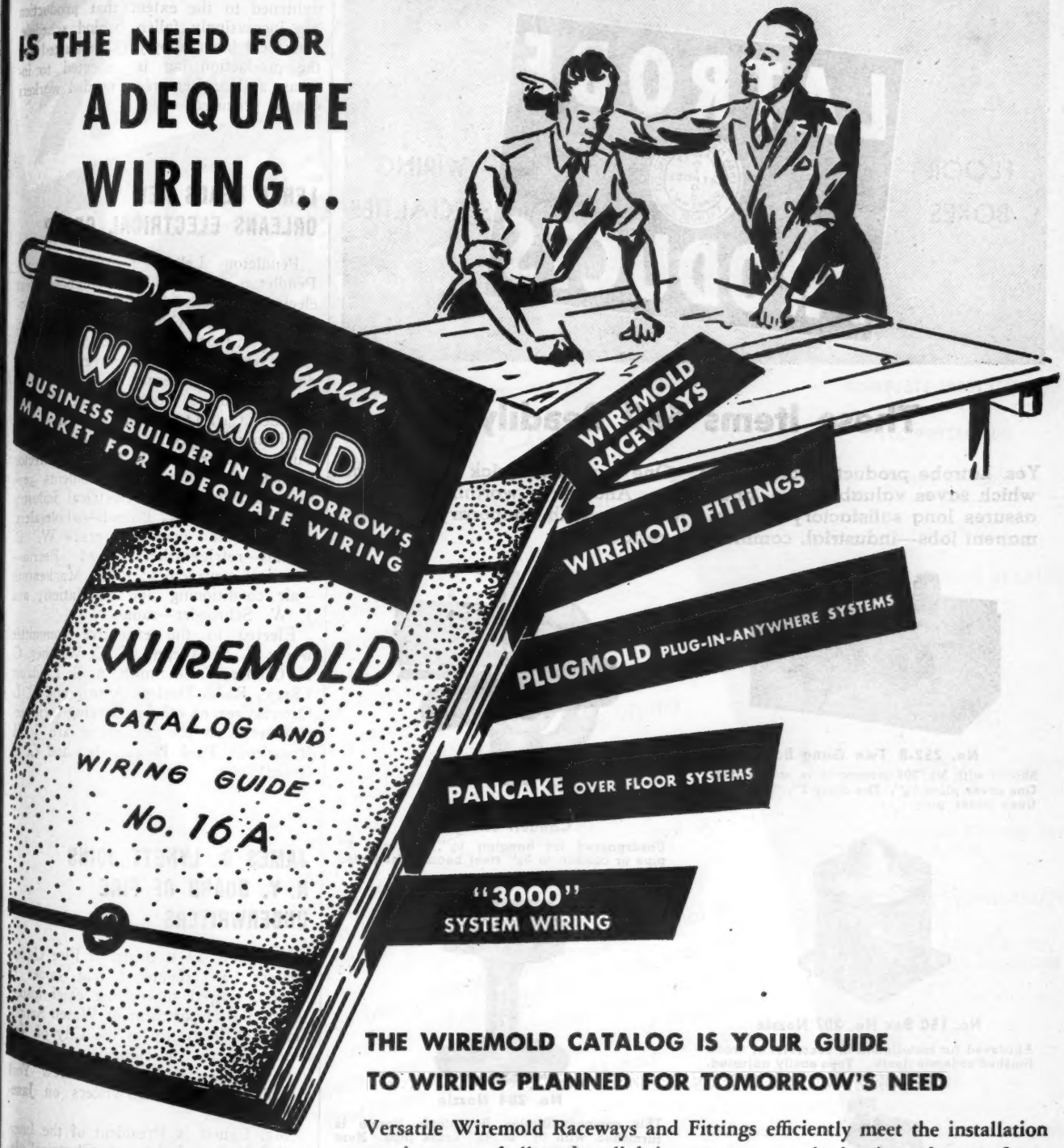
Three other areas, however, showed improved labor market conditions and were moved from Group II to Group III. They are Fresno, Calif.; Green Bay, Wis.; and Wilmington, N. C.

The principal war industry in Borger, Texas, is the manufacture of high octane gasoline. During the last few months the labor market situation in the area has

ELECTRICAL SPECIALISTS of Wynant Electric Shop, Pontiac, Illinois are busier than the proverbial bee. John Grundler (left) handles the wiring and construction assignment; John Wynant, the motor repair business.

—BEHIND *EVERY* LIGHTING PLAN . .

IS THE NEED FOR ADEQUATE WIRING . .



THE WIREMOLD CATALOG IS YOUR GUIDE TO WIRING PLANNED FOR TOMORROW'S NEED

Versatile Wiremold Raceways and Fittings efficiently meet the installation requirements of all modern lighting systems . . . whether incandescent, fluorescent or other newly developed light sources are used. In the Wiremold Catalog and Wiring Guide you will find the many sizes of raceway and the full range of fittings needed to plan either a complete basic wiring layout for new building construction or the wiring extension and relocation necessary in modernizing existing installations. Wiremold methods and materials are not new to you. They were your standby in prewar years. They have been widely used to speed work, save time and step up lighting standards in war plants throughout the nation. They stand ready now to become an essential part of your post-war business planning. If you have not received a copy of Wiremold Catalog No. 16A, write us at once.

THE WIREMOLD COMPANY, ARMY E NAVY **HARTFORD 10, CONN.**

ELECTRICAL CONTRACTORS

Business publications like these, with aggregate circulation of over 240,000 monthly among your prospects and customers, carry Wiremold advertising messages designed to HELP YOU BUILD BUSINESS. Tie in with this aggressive promotion program.

NEMA

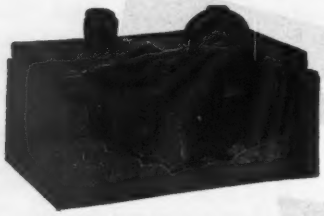
FLOOR BOXES

LATROBE PRODUCTS

WIRING SPECIALTIES

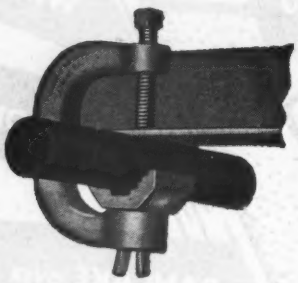
These Items Sell Readily

Yes, Latrobe products really move. One reason is quick *installation*, which saves valuable time, and labor. Another is *worthiness*, which assures long satisfactory service. Right for both temporary and permanent jobs—industrial, commercial, residential.



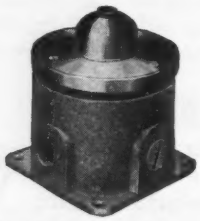
No. 252-R Two Gang Box

Shown with No. 208 receptacle in one section. One cover plate ½". The other 2". Both with flush brass plug.



No. 470 "Bull Dog" Pipe or Conduit Hanger

Unsurpassed for hanging ½", ¾" and 1" pipe or conduit to ⅜" steel beam. Used also as ground clamp.



No. 150 Box No. 207 Nozzle

Approved for installation in concrete, or wood finished concrete floors. Tops easily adjusted.

No. 284 Nozzle

This compact Duplex Receptacle Nozzle is furnished with ½" or ¾" brass pipe. Neat and very efficient.

"Bull Dog" Insulator Support

Nothing more convenient for fastening porcelain or glass insulators to exposed steel framework. Four sizes.

"Bull Dog" BX Cable Staples

Cartons, kegs and barrels.

QUALITY

FULLMAN MANUFACTURING CO. LATROBE, PA.

ALWAYS

tightened to the extent that production has increasingly fallen behind schedule. The local labor supply is exhausted and the production lag is expected to increase still further unless needed workers can be procured.

LEHDE HEADS NEW ORLEANS ELECTRICAL GROUP

Pendleton Lehde, president of the Pendleton Ship-building Company was elected president of the Electrical Association of New Orleans at the year-end meeting of that group last December. Mr. Lehde occupies the chair of retiring president C. L. Osterberger.

Other officers elected to the '45 slate include: Carl O. Brown, executive vice-president; J. R. Guidroz, secretary; I. W. Tufts, treasurer; W. E. Clement, director of publicity. New vice-presidents representing the various electrical industry groups are: E. R. Boruch—wholesalers, utilities and manufacturers; W. B. Wands—refrigeration; Fred Perrin—electrical contractors; R. A. Mackenroth—air conditioning and ventilation; and J. W. Schroeder—radio.

Elected to the executive committee were: E. N. Avegno, C. C. Walther, C. N. Olivier, T. G. Smith, A. B. Lindauer (Secy., Radio Dealers Assn.) and C. L. Osterberger, ex-officio. Serving their second term on the committee are J. H. Braselton; Paul Hogan, Jr., and C. S. Green.

JAMES D. LYNETT JOINS N. Y. BOARD OF FIRE UNDERWRITERS

The New York Board of Fire Underwriters has announced that James D. Lynett, retired supervising chief inspector of the Department of Water Supply, Gas and Electricity of the City of New York, became Superintendent of the Bureau of Electricity of The New York Board of Fire Underwriters on January 15, 1945.

Mr. Lynett is President of the International Association of Electrical Inspectors, a member of the Electrical Council of the Underwriters' Laboratories, Inc., Chairman of the Electrical Committee of the United States Conference of Mayors, a member of the Electrical Committee of the National Fire Protection Association, co-author of fourteen articles of the National Electrical Code and the author of the New York City Electrical Code. He is widely known throughout the United States and Canada and is highly regarded by all branches of the industry for his ability and integrity.

Mr. Frederic N. M. Squires who has been Chief Inspector of the Bureau for over 15 years and who has rendered very valuable service to the Board during this long period, both as an administrator and as a representative on important electrical

Farms need PORCELAIN too!

PROTECTED WIRING SYSTEMS

As rural electrification, so urgently needed, continues to increase, the job of the contractor in wiring homes and barns is most important. He must see that the farmer has all of the advantages possible from modern wiring.

The use of modern Porcelain Protected Wiring Products gives you, as a contractor, the opportunity to make installations that are not only profitable to yourself but that give the customer a low cost, dependable service that is complete in all ways for year after year.

It has been estimated that there is a total of 4½ million farms in the U. S. that can use electric service to advantage. You can make your share of these installations of maximum number through use of Modern Porcelain Protected Wiring Systems.

- COMPLETE INSULATION
- FULL PROTECTION
- SHORT PROOF
- SHOCK PROOF
- RUST AND CORROSION RESISTANT
- PERMANENT
- ADEQUATE
- ECONOMICAL
- MAXIMUM CURRENT CAPACITY RATINGS
- TAKES STANDARD DEVICES AND FIXTURES
- MEETS FUTURE LOAD INCREASE
- ALLOWS FOR EASILY MADE ALTERATIONS AND ADDITIONS

★ **ILLINOIS ELECTRIC PORCELAIN CO.** *Macomb, Ill.*

★ **PORCELAIN PRODUCTS, INCORPORATED** *Findlay, Ohio*

★ **SPECIALTY PORCELAIN WORKS** *East Liverpool, Ohio*

★ **SUPERIOR PORCELAIN COMPANY** *Parkersburg, W. Va.*

★ **UNIVERSAL CLAY PRODUCTS COMPANY** *Sandusky, Ohio*

MODERN PORCELAIN PROTECTED WIRING SYSTEMS

The rounded nose permits working in confined spaces—no sharp edges to nick wires
Matched jaws—serrated inside—for sure grip
Sharp knives are matched and honed to assure clean cutting
Hinge—perfect fit—jaws do not get out of alignment
Perfect balance with weight properly distributed makes Klein's easier to use
"Hand fit" handle
Spring tempering in the handle, prevents tiring hands
MATHIAS KLEIN & SONS
CHICAGO U.S.A.

WHY

Klein Pliers

STAND FIRST

Ask a lineman—electrician—or a skilled craftsman in any field why he prefers Klein pliers. He may mention the balance of Kleins that makes them feel comfortable—the sharp knives that stay keen even after years of service—the jaws that grip tight or the spring in the handles that prevents tired hands.

All of these qualities are evidences of the careful design—the years of experience—the hand-craftsmanship methods by which Klein pliers are made.

But even more they typify the careful control of every step in the manufacture—from the specification of the high grade tool steel made to our analysis to the individual inspection every pair of Klein's receives before it is boxed ready for shipment.

Obviously it costs more to produce pliers by Klein craftsmanship methods—but users of good tools recognize that the higher quality of these tools—the better service they render—the longer life they assure—are well worth the additional cost.

ASK YOUR SUPPLIER

Foreign Distributor:
International Standard Electric Corp., New York

Mathias KLEIN & Sons
Established 1857 — Chicago, Ill., U.S.A.
3200 BELMONT AVENUE, CHICAGO 18, ILLINOIS

Since 1857

committees, will continue to handle such responsibilities.

Mr. Thomas MacKie who has been Supervising Inspector is being advanced to the position of Assistant to the Superintendent.

It is believed that these administrative changes will insure the continuance of the high standards which have been the recognized practices of the Electrical Bureau for over 75 years and that the same will prove very beneficial in connection with the large amount of building and inspection work which is anticipated after the war.

BUILDERS' GUILD CONSTRUCTION FORUM TO BE HELD IN ST. LOUIS

As a means of bringing all branches of the building trades and allied groups up to date on the materials and planning advances made during the three year period since home construction has been permitted generally, C. T. Wilson, president of the Builders' Guild, has announced the Builders' Guild Construction Forum. The Forum program, which will cover the first two weeks of February, is being undertaken as a joint activity of the Guild and Producers' Council of St. Louis. It is expected to serve as a means of preparing all who will be responsible for home building and development in the metropolitan area to act promptly and efficiently immediately upon relaxation of restrictions on home building and the release of materials now under priorities control.

A program of six evening meetings, February 5, 6, 8, 12, 13 and 15, will be conducted at the David Ranken, Jr., School of Mechanical Trades. Two pertinent subjects, one in the field of materials and one on planning, will be covered each night.

Such rapidly developing and timely phases of home building as prefabrication, uses of plastics, air conditioning, heating and ventilating, kitchen planning, waterproofing and financing will be discussed and the progress of the past few years reviewed in such a way as to enable those responsible for the actual construction, as well as the designing, financing and supplying of materials to benefit.

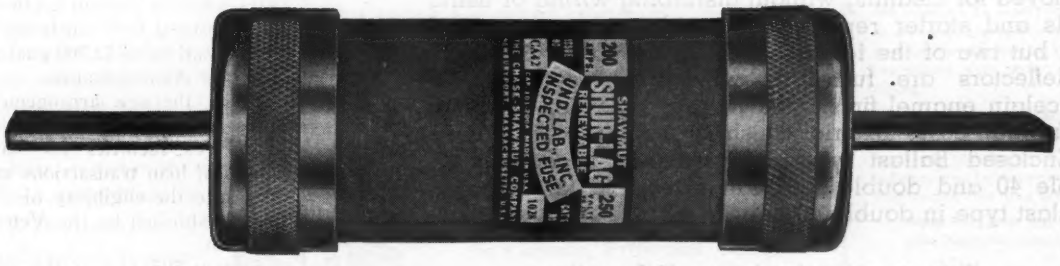
ELECTRIFICATION COSTS STUDIED ON TEST FARM

An Ohio farmer has started electrification of his 160-acre dairy farm in a fact-finding project to determine what can be saved in time, money and labor and what increases in production he can get through the use of electricity.

The project is being sponsored by the Westinghouse Electric and Manufacturing Company which hopes to obtain a detailed cost and production picture of the use of electricity on a small farm. Although aided by Westinghouse, Joseph Motz, operator of the farm in Trumbull

CONFIDENTIALLY

There never *has* been any better time-lag fuse than a SHAWMUT SHUR-LAG RENEWABLE FUSE. It has always been the fuse of today for tomorrow; the simplest, the sturdiest, the most speedily and easily renewed; in short, the fuse to use. To save shutdowns and delays in production, and completely protect your circuits and equipment, order SHUR-LAG and be sure.



THE CHASE-SHAWMUT COMPANY

NEWBURYPORT, MASSACHUSETTS

FUSE MAKERS SINCE 1893

ALL STEEL INDUSTRIAL FLUORESCENT FIXTURES

For

ESSENTIAL PLANT LIGHTING

OAMCO All-Steel Heavy Duty Industrials incorporate many desirable features for installations in plants where maximum lighting efficiency and minimum service delays are essential. Reflectors that can be removed for cleaning without disturbing wiring or using tools and starter replacements without lamp removal are but two of the features that speed up servicing.

Reflectors are furnished with either synthetic or porcelain enamel finish and have a reflection factor of more than 80%. Exterior finish is gray.

Enclosed Ballast type are furnished in double 40, triple 40 and double 100 watt sizes and the Exposed ballast type in double 40 only.

Write or wire today for our 1945 catalogs, Fluorescent #106 and Incandescent #104-A.

RIGHT LIGHT SINCE 1902

OVERBAGH & AYRES MFG. CO.

MEMBER OF THE R L M STANDARDS INSTITUTE

411 SOUTH CLINTON STREET • CHICAGO

County, is paying all power and equipment costs out of his income.

To set up a basis of comparison between farm work on a non-electric and an electric serviced farm, time and motion studies have been and are being made of all farm work done before the application of electricity and after. They are being done by Norman G. Wagy, of the Ohio Public Service Company, and are believed to be the first studies of this type ever made of a farmer's work.

The project is being supervised by the Doane Agricultural Service, of St. Louis, Mo., one of the country's leading farm management concerns. It will ascertain from Mr. Wagy's studies and Mr. Motz' farm records to what extent electricity is of value to the small farmer.

The time and motion studies already made show that the family annually carried 10.76 tons of drinking water into the house and covered a distance of 49.21 miles to accomplish this task.

Water for the dairy cattle, the studies indicated, involved carrying 604.8 tons of water and took 350 man-hours during the five-month period the cattle are watered in the barn. When an electric deep well pump is installed, Mr. Motz will save the equivalent of 35 working days.

A study is also being made of the daily job of milking and the amount of milk obtained. This study will be compared to the results obtained after milking equipment is installed by Mr. Motz. Doane agents believe that the winter output of the herd will be increased after water is electrically pumped to the barn.

FHA TO HANDLE LOANS MADE TO VETERANS UNDER SECTION 505

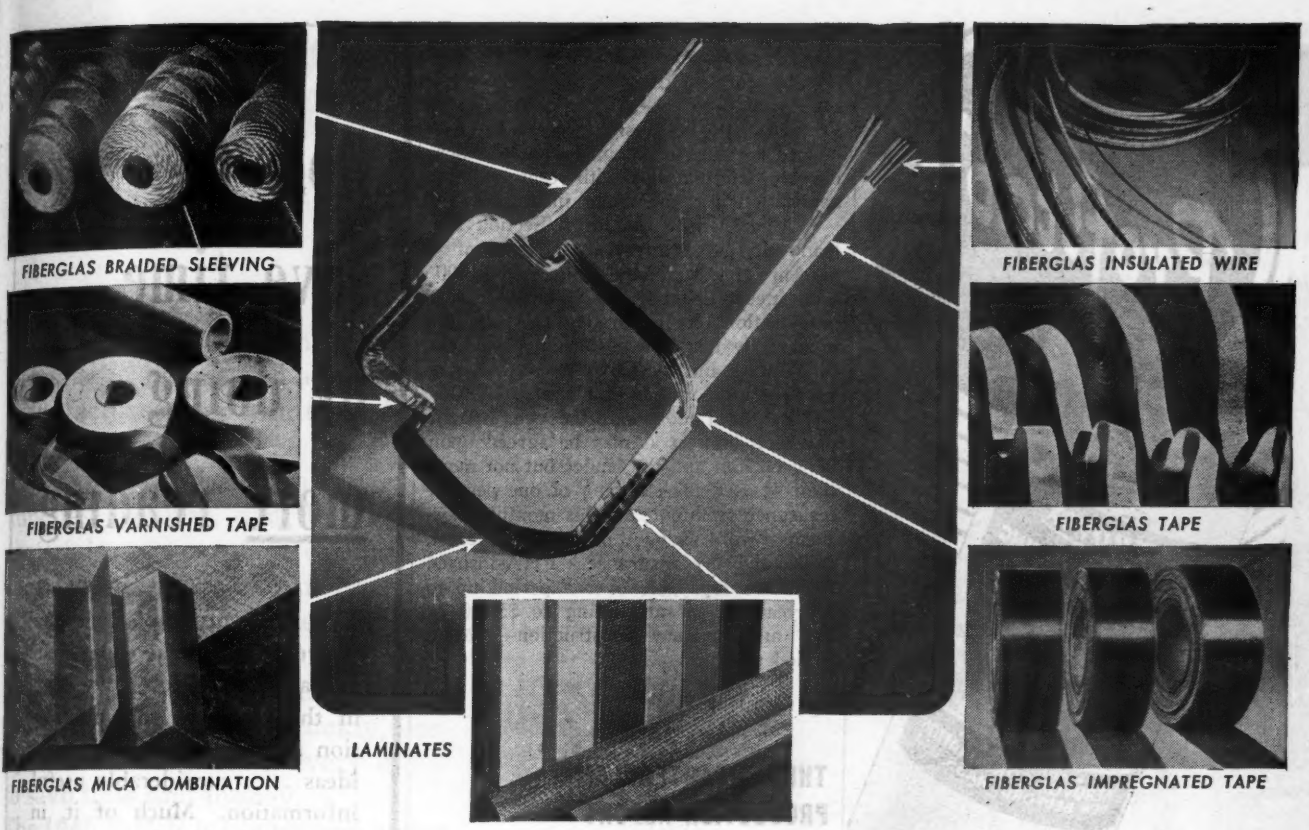
An agreement to utilize the facilities of the Federal Housing Administration for appraisal and reviewing purposes on loans made to veterans under Section 505 of the G. I. Bill of Rights, was recently announced by the Veterans Administration and the National Housing Agency.

The agreement is applicable in all cases where a veteran applies for both an FHA-insured first mortgage loan and an equity loan up to $2,000 guaranteed by the Veterans Administration.

Under the new arrangement, the Veterans Administration will take advantage of FHA's facilities for handling most details of loan transactions under Section 505, once the eligibility of a veteran has been established by the Veterans Administration.

Section 505 (a) of the so-called G. I. Bill of Rights in substance provides that if a principal loan is made, guaranteed or insured by a Federal agency the full amount of a second loan may be guaranteed by the Veterans Administration provided all other provisions of the statute are complied with but the amount of the Veterans Administration guarantee may not exceed 20% of the purchase price of the property and in no event more than $2,000.

The arrangement which has just been



A motor's best friend is its insulation!

The design skill and manufacturing excellence which go into most motors are frequently dissipated or completely wasted due to changes in operating conditions, the human element or other external causes of motor failure. Nationwide surveys show that motor insulation failures impose a tremendous time loss and cost burden on every industry.

In countless case histories it has been proved that Fiberglas Electrical Insulation Material provides the extra protection and stamina which is successfully overcoming many of the unanticipated causes of motor failure.

Fiberglas is glass in fiber form—as such, it retains part of the characteristics commonly associated with glass. And, because of its form, fibers finer than human hair, it gains several desirable characteristics which make it an unsurpassed insulating material when properly impregnated. In textile form Fiberglas provides a thin, strong, flexible, inorganic fabric base for insulating impregnants. This combination has unexcelled advantages and characteristics, and is available in Magnet Wire, Lead Wire, Special Wires and Cables, Varnished Cloth and Tape, Mica Combinations, Laminates, Saturated Sleeving, Varnished Tubing, Pressure-Sensitive Tapes and special products.

Anyone concerned with the specification or application of electrical insulation should have a copy of the new Fiberglas Electrical Insulation Material Catalog for ready reference . . . it tells what type to use, where and how. Write for your copy today and ask for the name of the Fiberglas Electrical Insulation Material supplier nearest to you . . . *Owens-Corning Fiberglas Corp., 1856 Nicholas Building, Toledo 1, Ohio. In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.*

FIBERGLAS combats these common enemies

Fiberglas provides all of the advantages of an inorganic material yet it has high tensile strength and an unusually favorable space factor.

MOISTURE. The individual fibers do not absorb moisture. They will not swell or disintegrate or become chemically affected through moisture contact.

HEAT. In textile form with close contact of fiber on fiber, Fiberglas has high heat conductivity and removes heat from "hot spots" to cooler areas where it is dissipated.

CORROSIVE CHEMICALS. Glass is not attacked by most corrosive vapors or acids. Fiberglas, therefore, provides an exceptionally durable support for the impregnant even under adverse conditions.

THE HUMAN ELEMENT. The added protection afforded by Fiberglas can frequently minimize or offset losses and failures, due to carelessness, lack of maintenance time and skill.

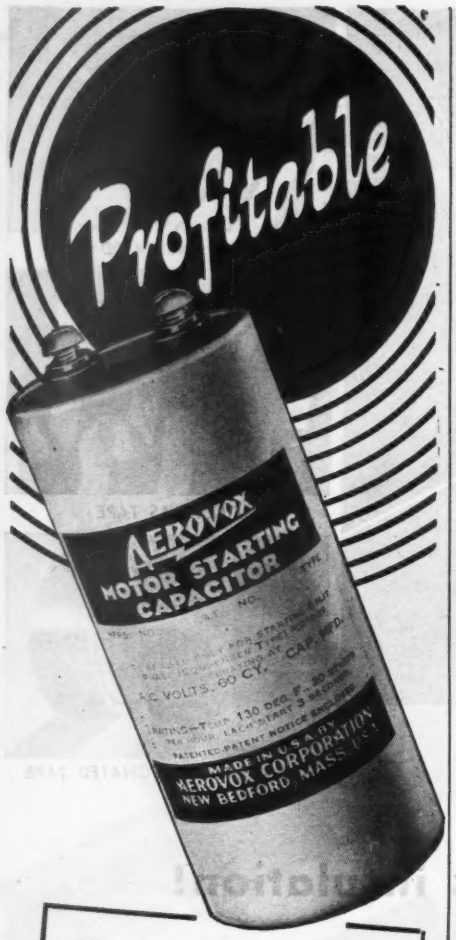
Write for your copy of the new Fiberglas catalog today.

BE SURE TO SEE THE FIBERGLAS ELECTRICAL INSULATION MATERIAL EXHIBIT ***THE NEXT SHOWINGS ARE:*** Copley Plaza, Boston, January 24-26; Bellevue Stratford, Philadelphia, January 30-February 2; Belvedere, Baltimore, February 7-8; Hotel Statler, Washington, February 14-15; Hotel Roosevelt, Pittsburgh, February 19-21; Hotel Statler, Buffalo, February 27-March 1. Further showings will be announced later.

ARMY E NAVY

FIBERGLAS ELECTRICAL INSULATION MATERIAL

*T. M. Reg. U. S. Pat. Off.



Wartime servicing line consists of 28 universal numbers. 22 for 110-volt, 6 for 220-volt operation.

These universal numbers can take care of upwards of 90% of all usual motor-starting capacitor replacements.

Handy Aerovox conversion chart indicates the universal number for any previously available type, for satisfactory performance. Minimum stock. Maximum service.

● Aerovox universal replacement capacitors are the answer to those wartime conditions and restrictions. A drastic reduction in number of types has been achieved without impairing satisfactory servicing. You can keep those electric refrigerators going for the duration, with Aerovox universal replacements. And it's mighty profitable.

ARMY (E) NAVY

● Consult your local jobber regarding these Aerovox universal replacements. Ask to see the conversion chart. Or write us direct.

AEROVOX Capacitors
INDIVIDUALLY TESTED
AEROVOX CORP., NEW BEDFORD, MASS., U. S. A.
In Canada: AEROVOX CANADA LTD., HAMILTON, ONT.
Export: 13 E 40 St., New York 16, N.Y. Cable: "ARLAB"

concluded has as its object the elimination of delay and expense, both to the Government and the veteran, in the processing of these cases by taking full advantage of the processing necessarily performed by the FHA in order to reach its own determination with respect to the application for mortgage insurance.

A veteran who obtains a Section 505 loan will pay interest at the rate of 4 percent on the amount, up to $2,000, guaranteed through the Veterans Administration; he can repay this amount in monthly installments over a period up to 20 years and the Government will pay the interest for the first year. On his FHA-insured mortgage, the veteran will pay such interest as may be agreed upon between him and the lender but not more than 4½ percent, plus a ½ of one percent insurance premium; and his monthly payments will include principal, interest, taxes and fire insurance. FHA-insured loans are repayable over a period up to 20 years or—if amounting to $5,400 or less and on new construction—over a period up to 25 years.

THIRD-QUARTER LAMP PRODUCTION REPORT

Production of electric lamps and bulbs in the third quarter, 1944, amounted to $34,629,000, and represented a decrease of 10.8 percent from the previous quarter. However, production of all types in the first three quarters of 1944 totaled $110,592,000, an increase of 23 percent over the same period of 1943.

During 1943 and 1944, over 79 percent of all electric lamps and bulbs were distributed through commercial channels with the percentage decreasing in the last two quarters to 75 percent. Military requirements for miniature incandescent lamps and photoflash lamps during the third quarter continued at high levels with the military taking approximately 50 percent and 42 percent of the shipments of each, respectively. Photoflash lamps have been showing a steady increase in recent quarters. These two types, however, during 1943 and 1944 account for only 15 percent of the total shipments.

The following data are for 28 companies, representing virtually the entire industry producing lamps and bulbs for illumination. Fluorescent bulbs include the RF and F types. Glow discharge lamps are mercury vapor and similar lamps, Large incandescent lamps are the usual household and commercial types. Miniature incandescent bulbs include those used for telephone switchboards, automobile headlights (excluding sealed beam lamps), flashlights, etc. Sealed beam lamps are specially designed units, containing bulb, reflector and lens, for use on vehicles for highway illumination. Photo-flash bulbs are designed to provide instantaneous high intensity illumination for photographic purposes. Lamps and bulbs for other than illumination purposes (such as infra-red and other therapeutic lamps) are not included. The following tabulation is in dollars and

How to save time by doing more reading

That is a profitable paradox for you. More true today than perhaps ever before. For here in the pages of this publication are packed many helpful ideas . . . considerable useful information. Much of it, in fact, available from no other source.

And we most emphatically mean *both* the editorial and the advertising pages.

Just one new idea gleaned from these pages . . . a method for doing something better or faster or easier or at lower cost, may alone save you far more than a year's reading-hours invested in this and other worthwhile business papers.

Many people have found this a fact . . . not only once, but time and time again. That's significant . . . with time so precious today.

Good advertising speeds information from those who have it . . . to those who need it.

★

McGraw-Hill Publishing Company, Inc.

330 West 42nd Street
New York 18, N. Y.

Reach first for E-B-R

E-B-R is an electrical man's best friend when he is looking for product data, or names and addresses of manufacturers, or wants to know *who* makes *what.*

In it you will find data on apparatus, supplies, fixtures, distribution line materials, power plant equipment, tools, repair parts . . . in fact, just about every product used by electrical men.

It is designed to fill your needs, to give you information quickly, easily. Use it today—and every day—to save time and money.

The 1945 E-B-R is bigger and better than ever. Its 724 pages are *crammed* with data, and give you:

MANUFACTURERS BRIEFALOG SECTION—
Condensed catalogs of 357 electrical manufacturers. Product specifications, listings of branch offices, warehouses, etc.

CLASSIFIED DIRECTORY OF MFGRS.—
Company addresses and trade names, arranged by product. Extensive cross-references to help you find the electrical and allied products made by more than 3,500 manufacturers.

INDEX OF TRADE & COMPANY NAMES—
Complete with addresses. Starting with only a trade name or a company name, you can thus quickly locate the product data you need.

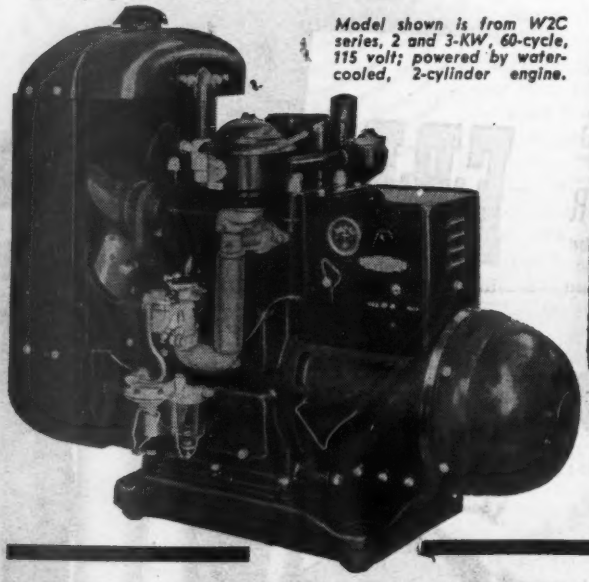
ELECTRICAL BUYERS E-B-R REFERENCE

McGRAW-HILL PUBLISHING CO., 330 WEST 42nd STREET, NEW YORK 18, N.Y.

ELECTRICITY
For Any Job—Anywhere

Reliable, economical electric service for electrical contracting projects anywhere, anytime, with an Onan Electric Generating Plant. From the 65 basic models, the right plant for any job or application, large or small, can be selected.

Driven by Onan built, 4-cycle gasoline engines, these power plants are of single-unit, compact design and sturdy construction. Suitable for all mobile, stationary or emergency service.



Model shown is from W2C series, 2 and 3-KW, 60-cycle, 115 volt; powered by water-cooled, 2-cylinder engine.

ELECTRIC PLANTS Onan
POWER AND LIGHT FOR EVERY NEED

Models range from 350 to 35,000 watts. A. C. types from 115 to 660 volts; 50, 60, 180 cycles, single or three-phase; 400, 500, and 800 cycle, single phase; also special frequencies. D. C. types range from 6 to 4000 volts. Dual voltage types, available. Write for engineering assistance or detailed literature.

Over 250,000 In Service

D. W. ONAN & SONS

2099 ROYALSTON AVE., MINNEAPOLIS 5, MINN.

Bend Conduit Cold—
Here's How
up to 90 degrees in one single operation with Tal's Prestal Pipe Bender

Conduit can be bent

40°

to any desired angle

60°

without moving pipe

90°

in one operation

Installation work goes faster, easier, and at a lower cost when you have a Tal's Prestal Bender on the job. This efficient, light, portable machine handles all pipe and conduit up to 3". Makes perfect bends, up to 90°, cold, in one single operation. No need to waste labor by replacing the pipe three to six times to make a bend. Does a good workmanlike job — smooth, uniform bends without kinks or wrinkles. Simple and easy to operate. Thousands are in successful use everywhere. Write for data bulletin.

Tal's Prestal Bender, Inc.
Dept. EC-2, Milwaukee 2, Wisconsin

represents the shipment volume of the various types of lamps for the third quarter 1944:

1. Fluorescent	$3,618,000
2. Glow Discharge	479,000
3. Large Incandescent	20,249,000
4. Miniature Incandescent	4,487,000
5. Sealed Beam	1,152,000
6. Photoflash	524,000

CANADIAN ELECTRICAL MANUFACTURERS ORGANIZE

R. D. Kerby, of Toronto, has been appointed general manager of the newly-formed Canadian Electrical Manufacturers Association. Mr. Kerby was formerly executive assistant to the president of Research Enterprises Ltd., and prior to that, was for some time assistant to the president of General Motors of Canada.

The Canadian Electrical Manufacturers Association will act as a central agency for the entire electrical manufacturing industry. The new Canadian organization is patterned after the National Electrical Manufacturers Association in the United States, and the British Electrical and Allied Manufacturers Association. Broadly speaking, its objects are to promote and further the interests of manufacturers of electrical products and the interests of the public in manufacturing, engineering, safety, transportation and other matters.

Provisional officers of the Association include A. B. Cooper, president of Ferranti Electric Limited, as president; M. P. Murphy, vice president of Amalgamated Electric Corporation Ltd., A. S. McCordick, vice president of Moloney Electric Co. of Canada Ltd., and J. S. Keenan, manager of the Supply Department of Canadian General Electric Co. Ltd., as vice presidents; L. E. Messinger, president of Canadian Line Materials Ltd., as treasurer; and A. R. Harper, Canadian General Electric Co., Ltd., as secretary.

ADEQUATE WIRING PROMOTED IN NORTHWEST REGIONAL MEETINGS

Adequate Wiring was emphasized before 600 electrical industry people gathered in two meetings sponsored by Northwest Electric Light & Power Association in late September and early October. Electrical manufacturers, wholesalers, dealers, contractors and utility people gathered to the number of 125 in Albany, Oregon, September 29, and 475 in Portland, October 2. The meetings were a continuation of a series of regional meetings being conducted in the Pacific Northwest to bring out the postwar planning being done by the several industry groups in that territory.

Howard Colburn, Graybar Electric Company, Portland, told the importance of electrical wiring in postwar home building with the aid of special visualizer charts. Many new appliances will not be

Not Time Yet for Paper Capers!

Sure, the news is good — terrific, in fact. But don't let that give you the idea that America's paper shortage is over. More paper than ever is needed now to wrap supplies for our armies as they drive toward their goal. There's still a manpower shortage in the pulp industry.

So, you've still got to watch your company's use of paper with the hawk eye of a paper miser.

You've still got to use your ingenuity and that of your staff to find even more ways to *use less paper.*

All material made of paper and paperboard still must be cut to the bone. Eliminate whatever you can until complete and final victory ends the paper pinch.

The baling of wastepaper and sending it to the reprocessing plant is still of prime importance.

Remember—
PAPER IS WAR POWER

USE LESS PAPER—SAVE ALL WASTEPAPER

This advertisement contributed by this publication and prepared by the War Advertising Council in cooperation with the War Production Board and the Office of War Information.

PARTS FOR CONTROLS MOTORS FANS

PROMPT SHIPMENT FROM LARGE STOCKS

AUTHORIZED PARTS DISTRIBUTORS

Brown-Brockmeyer
Century
Cutler-Hammer
Delco
Diehl
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Emerson
General Electric
Hamilton-Beach
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Howell
Hunter
Ilg
Leland
Marathon
Master
Peerless
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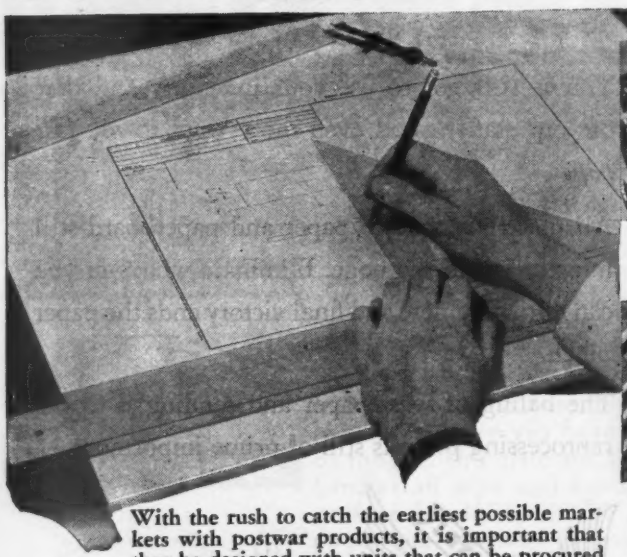
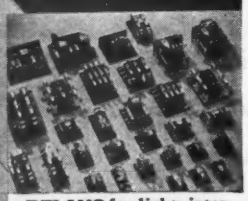
READING ELECTRIC COMPANY, INC.

Parts Distributors for the Manufacturer

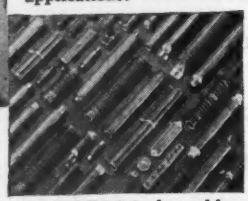
200 William St. Barclay 7-6616 New York 8, N. Y.

CONTROLS *FOR POSTWAR PRODUCTS*

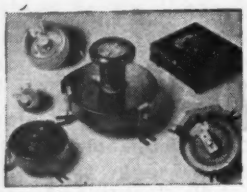




RELAYS for light, intermediate and heavy duty; for industrial and radio applications.



RESISTORS that withstand heat, moisture, vibration and other adverse conditions.



RHEOSTATS in a wide range of sizes, types and current ratings.

With the rush to catch the earliest possible markets with postwar products, it is important that they be designed with units that can be procured without undue delay. Manufacturers of equipment requiring electric controls will find Ward Leonard Relays, Resistors and Rheostats readily available without "time-out" for redesigning. Let us send you bulletins describing controls of interest to you.

WARD LEONARD

RELAYS • RESISTORS • RHEOSTATS

Electric control (WL) *devices since 1892*

WARD LEONARD ELECTRIC COMPANY • 28 SOUTH ST. • MOUNT VERNON, N. Y.

immediately available after the war, Mr. Colburn pointed out; but, if a home is wired so that they can be installed when they become available, the home owner will save the expense of rewiring at that time. Thus adequate wiring is the key to comfortable living for the postwar era. Mr. Colburn also pointed out that a large market for the electrical contractor is expected to become available, when war time restrictions are lifted, in re-wiring existing homes where the wiring has been found insufficient for the electrical load.

The postwar plans of manufacturers and distributors were presented at the two meetings by S. S. Brundige, General Electric Supply Corporation, Portland, while utility postwar promotion plans were told in Albany by Z. E. Merrill, president, Mountain States Power Company, and in Portland by J. H. Polhemus, president, Portland General Electric Company, and T. E. Roach, vice president and general manager, Northwestern Electric Company.

A lighting show bringing out new light sources, lighting trends and suggested applications was presented in two parts by Walter E. Potter, Lamp Department, General Electric Company, and H. L. Bargion, Lamp Division, Westinghouse Electric and Manufacturing Company.

Dr. G. V. Allison, formerly of the Edison Electric Institute, now with Puget Sound Power & Light Company, Seattle, closed the meeting with an inspirational message on the outlook of the electrical industry for the future. Berkeley Snow, executive secretary of the Association, acted as chairman of the meeting.

ELECTRICAL MANUFACTURERS INCREASED PRODUCTION IN 1944

The electrical manufacturing industry's production index for 1944 topped by five per cent the all-time record output of '43—despite the fact that ten-month indices for all industries showed a one per cent decline, W. J. Donald, managing director of the National Electrical Manufacturers Association, announced last month.

For the first time in the industry's history, production of non-electrical products accounted for a sizable percentage of the total, approximately one-quarter, Mr. Donald said.

Electrical manufacturers produced approximately nine billion dollars worth of products during 1944. Mr. Donald continued in his year-end summary. The biggest gain in the electrical field was in signalling and communications equipment, he declared. He attributed this to the "vastly stepped-up" output of telephone equipment—particularly field and ship telephones—and signalling apparatus.

Other increases noted were in illuminating equipment, insulating materials, and X-ray and therapeutic apparatus.

The output of industrial apparatus, wire and cable and transmission and distribution equipment continued steady with the 1943 record.

Appliance sales, already near bed-rock,

showed a still further dip, Mr. Donald said. There was a 50 percent drop in sales of major appliances such as refrigerators, washing machines, vacuum cleaners, ranges and water heaters—and this reduction offset the slight gain in sales of the small appliances. Sales of refrigerators, washing machines and ironers continued to come from pre-war stocks.

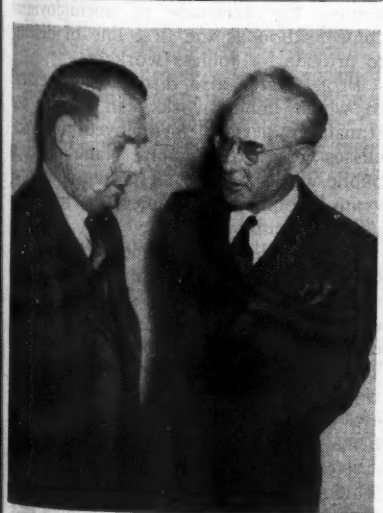
CONVENTIONS BANNED BY ODT

Organizations planning to hold conventions, conferences, trade shows or group meetings after February 1 "will have to show how the war effort would suffer if the meetings were not held," Col. J. Monroe Johnson, Chairman of the War Committee on Conventions, recently announced.

Members of the committee include Robert P. Patterson, Under Secretary of War; Ralph A. Bard, Under Secretary of the Navy; J. A. Krug, Chairman of the War Production Board; and Charles M. Hay, Deputy Chairman of the War Manpower Commission. The Committee appointed R. H. Clare, special assistant to Colonel Johnson, as secretary.

"The job of the committee," Colonel Johnson said, "is to achieve the objectives set forth by Justice Byrnes—to relieve overburdened transportation and hotel facilities and conserve desperately needed scarce materials and manpower. The hundreds of messages already received from organizations of diverse interests indicate that the nation is solidly back of our efforts. The committee has decided that the yardstick it will use to measure the essentiality of any meeting is how the winning of the two wars we are now fighting will be impeded if the meeting in question were held to an attendance of 50 or cancelled outright."

The committee approved the form of



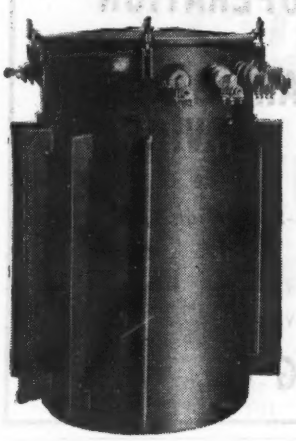
INTERNATIONAL LIGHTING problems are reviewed by (L to R) P. E. Tippett, Daylight Tube Lighting Co., Ltd., Adelaide, Australia and J. L. Stair of Curtis Lighting, Inc., at recent meeting of the Chicago Section, I.E.S.

NO. 2 OF A SERIES ON THE **Service Superiority** OF

DAVIS TRANSFORMERS

High all-day efficiency

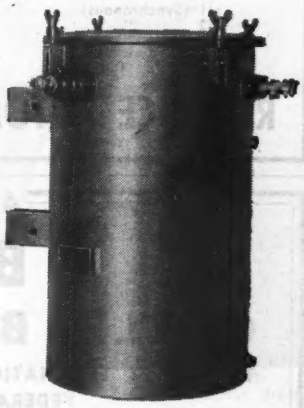
The design of Davis Transformers — a design based on our many years experience repairing and rebuilding transformers of every make, size and voltage — is to produce proper ratio between no-load and full-load losses. Smaller sizes in intermittent service have small no-load losses. Large sizes, under uniformly distributed load, have higher no-load losses, but full-load losses are correspondingly reduced. Since their introduction in 1935, Davis Transformers have set new standards of safety, reliability and economy because of the experience behind them.



DAVIS 100 KVA, single phase, 2400-120/240 Volts, Oil-cooled

For Example,

the 100 KVA, 2400-120/240 volt transformer shown below has efficiencies of 98.4% at full load and 98.2% at ¼ load, while the 10 KVA, 7200-120/240 volt transformer has efficiencies of 97.2% at full load and 97.6% at ¼ load.



DAVIS 10 KVA, single phase, 7200-120/240 Volts, Oil-cooled

- **REPAIRING AND RECONDITIONING**

For years we have been "transformer repair headquarters" for leading utilities and industrial companies. We offer complete repair and rebuilding service. All work guaranteed same as that of original manufacturer. A large stock of used transformers for sale — similarly guaranteed. Write us.

DAVIS TRANSFORMER COMPANY

DAVIS TRANSFORMER CO.
Phone 177 CONCORD, N. H.
and
STOCKWELL TRANSFORMER CORP.
CONCORD, N.H.—Phone 177 AKRON, OHIO—Phone Jefferson 4179
Manufacturers of Oil Cooled, Dry Type, Power and Distribution Transformers
Also All Types of Specialty Transformers Regardless of Size

NEMA

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Austin 8-4511

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F. M. NICHOLAS COMPANY
112 Harrison Street
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Tel. Underhill 4830

BADGER

Synchronous Automatic **TIME SWITCHES** *for*

ACCURATE TIMING

•

ECONOMICAL OPERATION

•

YEARS OF GOOD SERVICE

•

● *Prompt delivery on orders rated AA-5 or Higher.*

Type	Poles	Switch Capacity	Case
M1 (Synchronous)	1	50 A. at 125 V.	16 Ga. Steel
M2 "	2	50 A. at 125/250 V.	16 Ga. Steel
RM "	1	50 A. at 125 V.	Cast Iron
RM5 "	2	50 A. at 125/250 V.	Cast Iron

RELIANCE AUTOMATIC LIGHTING CO. RACINE WISCONSIN

A Complete Line of

BAKELITE

OUTLET BOXES *and* COVERS

THAT MEET THE NATIONAL ELECTRICAL CODE AND APPROVED BY FEDERAL HOUSING ADMINISTRATION

BOXES FURNISHED WITH OR WITHOUT CLAMPS

No. 3050 No. 4050 No. 5050 No. 6050 No. 7050

Nos. 3051 & 4051 Nos. 3052 & 4052 Nos. 3053 & 4053 Nos. 3054 & 4054 No. 4055 Nos. 3057 & 4057 Nos. 3056 & 4056

SAFE • ECONOMICAL • DURABLE • NEAT

The sizes and design, except for clamps and wire knockouts, same as standard metal outlet boxes. They take standard type of fixture studs. Two clamps supplied with each box. The wire clamps hold against 125 lbs. pull. When used with fixture studs they withstand over 400 lbs. pull on stud.

These Bakelite Outlet Boxes have side knockouts and clamps to take 14-2, 14-3, and 12-2 non-metallic sheathed cable, and 14-2, 14-3, 12-2 and 12-3 CNX Type Cable and one ½ in. Bottom Knockout.

These covers are sufficiently thick to obviate breakage in installation or use. Standard color Black.

UNION INSULATING COMPANY, INC.

FACTORY: PARKERSBURG, W. VA.

SALES OFFICE: 27 PARK PLACE, N.Y.C.

application required of organizations planning group meetings to be attended by more than 50 persons. Information required by the committee includes:

Whether the planned meeting is a convention, conference, trade show, or government meeting; the date and location of the proposed meeting and name of hotels or other facilities that will be used; attendance planned; previous frequency of meetings; location and attendance of last previous meeting; average attendance at similar meetings before the war and during the war; from what area those attending are drawn; what steps have already been taken to curtail attendance; why the objectives of the meeting cannot be attained through "Conventions by Mail"; why a group of 50 or less to whom powers are delegated cannot transact the necessary affairs of the organization and in what way and to what extent the war effort would suffer if meeting were not held.

CED COMPLETES STUDY ON TRANSITION UNEMPLOYMENT

Five steps to meet problems of the nation's unemployed in the transition period of conversion from war to peace economy are recommended in a study just completed for the Committee for Economic Development. Richard A. Lester, author of the study and Associate Professor of Economics in Duke University, urges strongly that action be taken now to reduce seriousness of the effects of this unemployment. Later the CED Research Committee will issue a policy statement covering the subject of transition unemployment.

Beyond winning the war, Prof. Lester cites transition unemployment as one of the nation's greatest problems. He points out that by planning now business can do much to reduce the volume and duration of transition unemployment. He examines the adequacy of unemployment compensation as the first line of defense to provide for jobless workers.

Prof. Lester also discusses the extent to which public works can provide for transition period unemployed and discusses ways to stimulate planning for a public works reserve. His five point program recommended to meet the transition period unemployment is:

1. Unemployment compensation, as the chief means for providing for workers during the transition, should have its coverage extended and its benefits increased. Coverage should be extended to include federal agency employees, workers in federal shipyards, arsenals, etc., merchant seamen and workers in firms with fewer than eight employees. Lester recommends that those states which have not already done so increase their schedules to permit maximum benefits of $20 a week for 26 weeks.

2. Employers should plan postwar rehiring as far ahead as is practical, using as many of their employees as possible during transition on maintenance, repair, alteration and development work. Where

wartime contracts are terminated without sufficient notification, payments should be made in lieu of two weeks dismissal notice to employees. Where travel expenses were paid workers to take jobs in distant cities, provision should be made for return travel cost.

3. Short term education and basic training courses, both general and vocational, should be available without cost to the jobless, with federal funds matching those raised for this purpose by states and localities. These courses, to which workers would be referred by the United States Employment Service, would contribute to job mobility, as well as give workers opportunity to improve their productivity.

4. State and local public works programs should be planned now, for use when needed to provide employment. Prof. Lester recommends that the Federal government match local funds to speed advance planning for such works. He maintains that a Federal expenditure of $150,000,000 for this planning would prepare for public works to cost seven or eight billion dollars after the war.

5. Congress should enact a program of federal grants to the states for general assistance on a matched basis, similar to that used in federal-state payments to the needy aged, the needy blind and to dependent children.

Total Federal cost of all these proposed measures, in a two-year period after the war, is estimated by Prof. Lester at about $1,250,000,000, the approximate government expenditure in five days of the present war period.

Declaring that transition unemployment may continue for a year and a half to two years after final victory, Prof. Lester asserts that "present provisions for job casualties are inadequate," and urges prompt action on his five point program by the 44 state legislatures holding their first 1945 sessions this month and next.

He estimates total unemployment is likely to reach a peak of at least 4,000,000 to 5,000,000 during reconversion and says that "unless things go well this total may go considerably higher." He points out that while unemployment compensation funds totaling more than six billion dollars have been accumulated, the reserve is divided into 52 separate funds each of which can be used only within a state or territory.

The result, he says, is the same as having 52 fire departments in separate areas of a single community, yet prohibiting one from going to the aid of another in case of a conflagration. He proposes a central Federal reserve fund to protect any state whose reserves may become exhausted during transition.

There will be 45,000,000 persons entitled to unemployment benefits after the war, the report says. There will be, however, wide variation between state payments, resulting, for example, in workers in the same pay range receiving weekly benefits of $7 in North Carolina, $13 in Louisiana. Similarly a worker entitled to total benefits of $220 in New York could draw only $100 in New Jersey. National average of benefit checks

CUT ANY SIZE HOLE IN

5/8" to 1 1/2" with one

Sheet Metal
Boiler Plate
Dural
Plastics, Wood
Masonite
Hard Rubber
or Fibre

BRUNO Adjustable HOLE CUTTER

ONLY $2.95

Cut Holes 1" to 2½" With Bruno No. 101 $4.95

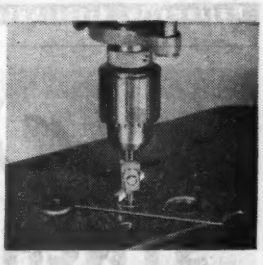
NOW AVAILABLE FOR ALL USERS! A single Bruno Hole Cutter does the work of many fixed-radius tools, from 5/8" to 1 1/2".

Two Bruno Hole Cutters give a cutting range of 5/8" to 2 1/2". Both cut steel, sheet metal, plastics, wood, hard rubber, fibre and other materials.

Bruno No. 100 has ¼" straight shank. Also furnished as 100-B, with bit stock for braces. Cutting range 5/8" to 1 1/2". Both $2.95. Model No. 101 has 3/8" straight shank (No. 101-B optional, with square bit stock) and priced at $4.95. Cutting range 1" to 2 1/2".

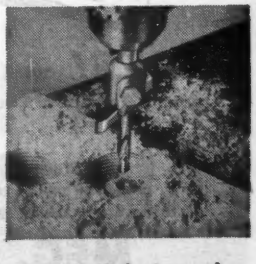
NOTE: MONEY-BACK GUARANTEE! SEE YOUR JOBBER OR WRITE DEPT. EC-1.

BRUNO TOOLS
9330 SANTA MONICA BOULEVARD
BEVERLY HILLS, CALIFORNIA



Ideal for electric drills and light drill presses.

No trick to set and re-set adjustable cutting blade.



Cut deep holes in wood or compressed material.

HYDEE Industrial FIXTURE HANGER

SAVE DOLLARS ON Maintenance . . . Repairs . . . Operation

No need to center, punch or drill holes when you use the HYDEE Hanger for chain-suspension of Industrial Fixtures — for new installations or "change-over" jobs . . . Simply make wiring connections — screw the hanger to the outlet box — then hang the fixture.

$1.50 LIST PRICE

Complete with two 5-ft. chains, cord clips, "S" hooks and receptacle.
UNDERWRITERS APPROVED

Day Brite LIGHTING FIXTURES

DAY-BRITE LIGHTING, INC.
5404 Bulwer Avenue • St. Louis 7, Missouri
Nationally distributed through all leading electrical supply houses

20 PAGES OF HELPFUL FACTS ABOUT... SYNCHRONOUS MOTORS

A brand new booklet, full of practical, authentic data on synchronous motors. Prepared and edited by specialists. Attractively illustrated and printed in 3 colors. Complete with helpful charts, photos, etc

Partial Contents

"WHAT MAKES THE SYNCHRONOUS MOTOR RUN?"

"HOW SYNCHRONOUS MOTORS ARE BUILT"

"HOW TO CALCULATE POWER FACTOR PROBLEMS"

"SELECTION CHART FOR SYNCHRONOUS MOTOR CONTROL"

FREE! Write today for your copy of "The ABC of Synchronous Motors"

A2005

ELECTRIC MACHINERY MFG. COMPANY
1339 Tyler St. N. E., Minneapolis 13, Minn.
E-M

in 1943 was $13.84 a week, but five states had averages below $10, including $7.10 in North Carolina, $9.09 in Maine, $9.31 in Kentucky, $9.54 in South Dakota and $9.57 in Delaware.

In urging that income of jobless workers be raised through increased unemployment compensation benefits, Lester re-emphasizes that the ability of business to provide jobs depends upon markets for goods and services. Long periods of unemployment with little or no income destroy this buying power and this in turn lengthens transition joblessness, Lester holds.

The report to be published in the very near future in book form by the McGraw-Hill Book Co.

WMC ISSUES LIST OF ESSENTIAL ACTIVITIES

The War Manpower Commission has announced a list of essential and critical activities to be used by Selective Service as a guide in the induction of men in the 26 through 29 age group, in accordance with the directive issued recently by James F. Byrnes, director of War Mobilization and Reconversion.

The list was drafted after consultation among representatives of the Army, Navy, Selective Service, War Production Board and the War Manpower Commission.

All activities in this list are essential activities. Those activities printed in italics are critical activities. With one exception, no attempt has been made to indicate the relative importance of different occupations in these activities. *All technical, scientific and research personnel engaged in any of the activities* in the list, whether or not the activity appears in italics or small letters, are regarded as being engaged in critical activities.

Some activities included in this list are limited to the production of essential products as, for example, in Group 13 only the production of metal shapes and forgings for essential products are included. When such limitations are indicated essential products refer only to those included in this list.

The list follows:

1. Production of Aircraft and Parts.—*Production, maintenance, and repair of aircraft, gliders, parachutes, dirigibles, balloons, aircraft engines, aircraft parts, pontoons, propellers, and similar products.*

2. Production of Ships, Boats and Parts.—*Production, maintenance, and repair of ships, boats, ship and boat parts and equipment.*

3. Production of Ordnance and Accessories.—*Production, maintenance, and repair of firearms, guns, howitzers, mortars, gun turrets and mounts, tanks, sighting and fire-control equipment, torpedo tubes, and similar products.*

4. Production of Ammunition.—*Production of bombs, mines, torpedoes, grenades, chemical warfare projectiles, small arms, rockets, explosives, fuses, pyrotechnics, as well as products such as glycerin which go into the manufacture of ammunition.*

5. Agriculture and Commercial Fishing.

(a) Agriculture.

(b) Agricultural Services. — Agricultural, horticultural, and animal husbandry services such as: Commercial poultry hatcheries, seed processing, animal breeding. crop disease protection services, initial processing services such as ginning, compressing, threshing, cleaning, shelling and curing, irrigation services, farm repair and maintenance services, farm

product assembly services, grist milling (custom); ice harvesting.

(c) Commercial fishing. — Including fish hatcheries (conservation or commercial) and sponges: Gathering, bleaching, cutting, and trimming.

6. Processing of Food.—*Meat* and poultry packing and slaughtering, production of *dairy products, eggs,* fish and nuts, fruits and vegetables and their juices, soups, flour and other grain mill products, prepared feeds for animals and fowls, starch, cereals, rice, bread and other bakery products, *sugar,* leavening compounds, corn syrup, fats and oils, ice. Includes dried, preserved, dehydrated, frozen, canned, and other special-processed foods.

7. Forestry, Logging, Lumbering, and Forest Industries.—*Timber tracts and logging camps, cutting of pulpwood, wood for tanning extract, charcoal, sawmills, veneer, cooperage stock, planing, and plywood mills,* raising of tung oil trees; fire prevention, pest control; forest nurseries and reforestation services; gathering of gums and barks for the manufacture of naval stores and medicinal purposes.

8. Construction.—Highway and street construction; marine construction; *construction of approved industrial plants,* houses, *hospitals, and military projects;* repair of such facilities; and services necessary to complete such construction.

9. Coal Mining.—*The mining of anthracite bituminous, and semianthracite coal,* Lignite, and peat, and the operation of breakers or preparation plants. Includes also removing overburden and other such activities preparatory to coal mining operations.

10. Metal Mining.—*The mining of iron, copper,* tin, *lead, zinc,* aluminum, *mercury,* manganese, chromium, *molybdenum,* tungsten, *vanadium* and similar ores, and the dressing of such ores. Includes also removing overburden, sinking shafts, and other such activities preparatory to metal mining operations.

11. Nonmetallic Mining and Processing and *Quarrying.*—The mining, processing, or quarrying of salt, gypsum, *phosphate rock, sulphur,* potash, asbestos, *graphite, pyrites, graphite, borates and other salines, fluorspar,* mica, *talc, abrasive sands,* calcite (optical), and similar essential products.

12. Smelting, Refining, and Rolling of Metal; Scrap Salvage.—*Primary and secondary smelting, and refining, alloying, rolling, and drawing of iron, steel, copper, lead, zinc, magnesium, aluminum, brass, bronze, nickel, tin, cadmium, ferro-alloys, and any other metals used in the production of war materials;* and scrap salvage.

13. Production of Metal Shapes and Forgings for Essential Products.—*The manufacture of castings, die castings, forgings, wire, nails, chains, anchors, axles, pipe, springs, screws, bolts, tubing, stampings, pressings, structural shapes, and machine parts for essential products.*

14. Finishing of Essential Metal Products.—Enameling, japanning, lacquering, painting, plating, galvanizing, aluminum coating, polishing, rust-proofing of essential metal products; sherardizing, retinning.

15. Production of Industrial and Agricultural Equipment.—*Power boilers, wiring devices and supplies; agricultural implements; electric lamps; storage and primary batteries; pumps, compressors, and pumping equipment; recording, controlling and measuring instruments and meters; conveyors, industrial cars and trucks; blowers, exhaust and ventilating fans; mechanical power-transmission equipment, such as clutches, drives and shafts; mechanical stokers; tools, files, and saws; plumbers supplies; professional and scientific instruments, photographic apparatus, and optical instruments; and all equipment necessary to operates plants producing essential commodities;* leg and wing bands; cooking, steaming, and dishwashing equipment designed for mass feeding; paint brushes and paint brush handles.

16. Production of Machinery.—*Engines and turbines; metal-working machinery and equipments; electrical generating, distribution, and industrial apparatus for electric public utility, manufacturing, mining, transportation, and construction use, for use in manufactured products or in service industries; construction mining, agricultural, oil field, smelting, and refining machinery, as well as all machinery necessary to produce, equip, and maintain aircraft, ships, ordnance, and other military equipment.*

17. Production of Chemicals and Allied Products.—*Industrial organic chemicals, coal and petroleum crudes, coal tar intermediates, dyes, color, lakes and toners, explosives and components of explosives, synthetic fibers, synthetic rubbers, plastics materials, non-coal-tar intermediates and solvents, and miscellaneous organic chemicals; gum and wood chemicals, plasticizers, rubber chemicals, and tanning extracts. Drugs, medicines, and insecticides; drug grinding, crude botanical drugs, botanical drugs, derivatives and synthetic equivalents, biological products, drugs of animal origin, pharmaceuticals for use in proprietary remedies and prescriptions, insecticides, fungicides, fumigants, rodenticides, and laboratory animals for biological and pharmaceutical experimenta-*

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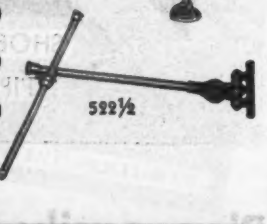

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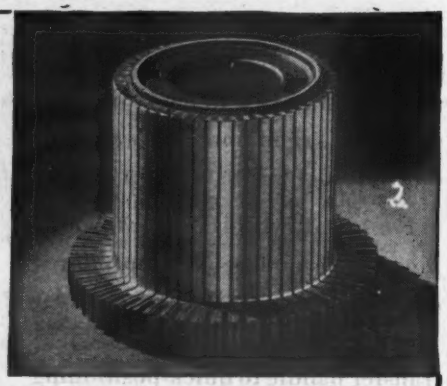

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18. Production of Essential Rubber Products. —*Essential rubber products—tires, tubes and other essential products including parts and components of other products included in the essential activities list.*

19. Production of Leather Products.—*The production of shoe and belting leather; industrial belting for transmission of power;* saddlery, harness, and accessories; military, safety and rationed boots and shoes; infants' shoes (sizes through 4); gloves and leather garments for military and industrial use.

20. Production of Textiles.—*Production of cotton duck, tent twill, tire cord, including synthetic fibers, nylon cloth, netting (including rope netting); processing of all materials for rope and twine, rope making: production of wool tops, processing and spinning of worsted yarn.* Production of textiles including the processing, manufacturing, bleaching, dyeing, printing, and other finishing of textile cordage, fabrics (excluding wool or fur felt for hats and fancy fabrics such as brocades, chiffons, damasks, laces, velvet, etc.), fibers, nets, rope, twine, yarns, made of or using any of the following materials: Animal hair (other than wool) such as bristles, alpaca, etc; asbestos, cotton, fibrous glass, flax, hemp, henequen, jute, kapok, manila, nylon, rayon, rubber, silk, sisal, shearings; waste (processed), wool, other synthetic filaments or fibers.

21. Production of Apparel.—Apparel for the armed forces; work clothing; snowshoes; the following infants' and children's wear (woven and knit) when produced under the War Production Board's "Critical Infants' and Children's Apparel Production Programs." (1) Underwear and nightwear (a) through age 6—bands, crib blankets, diapers, gowns, kimonos, pajamas, panties, shirts, sleepers, training panties, wrappers; (b) age 6 through age 16—bloomers, briefs and/or shorts (boy's) pajamas, panties, sleepers, slips, union suits (heavy weight), vest, pants; (2) outerwear (a) through age 6—coat and legging sets, snow suits, sweaters; (b) age 6 through age 16—jackets, long pants and/or slacks (boy's), mackinaws, short pants (boy's), sweaters; (3) Play togs (a) through age 6—overalls (toddler's) rompers and/or creepers, sun suits, wash suits; (b) age 6 through 16—polo shirts; (4) Utility garments (a) through age 6—anklets, coveralls, dresses, dungarees, overalls, ribbed hose; (b) age 6 through age 16—coveralls, crew sox (boy's), dungarees, overalls, shirts (boy's), work gloves (small, medium, large).

22. Production of Stone, Clay and Glass Products.—*Scientific and industrial glass products: acid-proof brick, firebrick, and other refractory products; chemical lime; abrasive wheels, stones, paper, cloth and related products;* asbestos products including steam and other packing, pipe and boiler covering; crucibles and retorts: gypsum board; mineral wool (for insulation); procelain insulators and bushings for high voltage and radio application; vitrified china for mass feeding.

23. Production of Petroleum Natural-Gas and Petroleum and Coal Products.—*Explorations, drilling, rig-building, production of petroleum, natural gas, and gasoline, and field service operations, and petroleum refining. Production of tar and pitch, coal gas, coke, and liquefied petroleum gas.*

24. Production of Finished Lumber Products. —Cork products such as life preservers; storage battery boxes; insulating material; oars; matches; crutches; caskets; wood preservation activities; buildings, portable and prefabricated; wood base hardboard. *Wooden parts of aircraft, ships, and other military equipment.*

25. Production of Transportation Equipment. —*The production of motor vehicles, trucks, ambulances, fire engines, busses, and military motorized units; essential parts and accessories of such motor vehicles; motorcycles, bicycles, and parts; locomotives and parts; railroad and street cars, and equipment.*

26. Transportation Services.—*Air transportation; line-haul railroad; switching and terminal; railway and air express; freight forwarding; rail inspection; maintenance and re-*

pair of railroad equipment, buildings, right-of-way, and rolling stock; local transit, rapid transit, interurban electric railway, and *over-the-road bus; offshore and intercoastal water transportation, including shore service such as stevedoring and harbor operations; pipeline transportation; transportation services on the inland waterways, Great Lakes, harbors, bays, sounds, and waters connected with the seas, including shore service such as stevedoring; over-the-road trucking; warehousing of essential (perishable and non-perishable) commodities;* operation of highway bridges.

27. Production of Pulp, Paper and Materials for Packing and Shipping Products.

(a) Production of the following pulp, paper, paperboard and converted products. — Pulp (made from pulpwood and other substances); the following types of paper stock and paper board: Asborbent for impregnation, asphalt laminating, blueprint, box board, butcher papers (untreated and treated), cable and electrical insulation, carbonizing, chart and map (Government), condenser tissue, container board, drafting, filter, fruit and vegetable wrapping tissue, gasket, glassine, greaseproof, gumming, mandrel winding stock, pattern tissue, photographic and other sensitized, rope and jute, safety base stock, sanitary (sanitary napkin stock, toweling stock, napkin stock, toilet tissue stock, hospital wadding stock), shipping sacks stock, tabulating card stock, tracing, twisting and spinning, vegetable parchment, waxing, wet machine board, wrapping (machine finished and machine glazed); the following converted products from paper and paperboard: ammunition, and shell cases, carbon, envelopes used for shipping and preserving essential products; fiber drums, gummed paper tape, hospital wadding, laminated waterproof and heavy crepe, liquid tight containers and closures, mandrel wound, mesh cloth and fabrics, napkins, nested paper cups, nested paper food containers (excluding paper plates), paperboard boxes and shipping containers, sanitary napkins, shipping sacks, toilet tissue, towels, twine, waxed, waxed laminated and resin impregnated papers for food, munitions, and industrial wrapping.

(b) Production of Other Materials for shipping and preserving essential products.—Bagging, jute, meat; bags, textile (except laundry bags); barrels, metal; baskets (Climax, fruit, vegetable); box shooks; boxes (metal, wooden and paperboard); cable, fiber; cans; cases, packing; containers (glass, metal, ad wood; caps and closures for such containers); cooperage; cooperage stock (staves, headings and hoops); *cordage;* crates; drums (shipping); excelsior; gummed cloth tape; *rope;* tin cans.

28. Production of Communication Equipment. —*Radios and radio equipment; radar; telephone, telegraph, cable, television, signalling apparatus; electrical sound equipment; vinylite transcriptions;* telautograph; teletype tape, not to exceed width of one inch.

29. Communication Services.—Magazines of general circulation which are devoted primarily to the dissemination of public information; newspapers and news syndicates, *military, naval, and technical charts and maps, instructional and technical manuals,* and training literature; production of motion pictures (including technical and vocational training films for the Army, Navy, and war production industries); motion picture film processing, news reels; development of sensitized film; protective signal systems which supplement fire and police protection to military, public and private industrial and commercial establishments; radio broadcasting; *radio communications (radio-telephone and radiotelegraph); cable service (land or submarine); telegraph; telephone;* television; production for essential activities of continuous forms with or without one-time carbon, and produced on rotary equipment; and production of salesbook-type forms contracted for by governmental agencies.

30. Heating, Power, Water Supply and Illuminating Services. — *Electric light and power, water, and gas utilities; steam-heating services; sewage systems;* tree trimming for power and communication lines; water-well drilling (industrial and utility water supply); installation and servicing of liquefied petroleum gas facilities.

31. Repair Services.—*In-plant maintenance and repair of industrial and mining machinery and equipment;* repair of: vehicles, such as bicycles, motorcycles, *automobiles, busses, trucks, tractors and farm equipment; tires;* typewriters and business machines; elevators; shoe repairing; sewing machines; radios; refrigerators; clocks and watches; harnesses; tools; stoves, pneumatic tube systems; power laundry equipment; electric appliances and motors, engines, heating equipment; scientific, commercial and industrial weighing machines; farm and other industrial and scientific equipment; welding service; roofing, and electric gas and plumbing and heating installations in domestic, commercial, and industrial buildings; building alteration, maintenance and repair, installation of insulating material; blacksmithing; armature rewinding; locksmithing. *(It is intended that consideration be given only to individuals qualified to render all-around*

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IT LEADS THEM ALL

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1 Positively cuts out deactivated, flickering, blinking lamps.
2 When trouble is detected the starter automatically cuts off current to the ballast and lamp.
3 Gives long life to ballast because defective lamp is locked out. Prevents overheating.
4 When Lloyd AUTOMATIC locks out defective lamp—turn off the current—Remove defective lamp—Put in a new lamp. Allow at least one minute to make the above change of lamps. Turn on the current. The starter automatically lights the new lamp.

NO NEED TO DO ANYTHING TO THE STARTER

5 Lloyd NEW PLASTIC CAN has higher dielectric strength, is stronger, lighter, distinctive.
6 Knurled rim on plastic can insures positive grip for insertion and removal of starter.
7 Plastic can is sealed. No projecting lugs to cause trouble.
8 The life of the AUTOMATIC starter is many times greater than that of the average lamp.
9 It saves maintenance costs and power consumption, protects and insures longer life to the ballast and lamp.
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repair services on the types of equipment specified herein.)

32. Health and Welfare Services.—*Physicians, surgeons, dentists, oculists, osteopaths, pediatrists (chiropodist), sanitary engineers, and veterinarians (engaged in treatment of farm livestock);* offices of the preceding professions; *medical, dental and optical laboratories: pharmaceutical services; hospitals; nursing services; institutional care;* mortuary services; auxiliary civilian welfare services to the armed forces; welfare services to civilians; church activities; accident-and fire-preventive services; structural pest control services.

33. Educational Services.—Public and private industrial and agricultural vocational training; elementary, secondary, and preparatory schools; junior colleges, colleges, universities, and professional schools, educational and scientific research agencies; *United States Maritime Service Training Program;* Civil Aeronautics Administration Civilian Pilot Training Program; armed forces contract flying, ground and factory aviation schools; and the production of technical and vocational training films.

34. Governmental Services.—Federal, other than Federal; cobelligerent. *Note:* (Deferment of Federal employees subject to Public Law 23 and Selective Service instructions issued pursuant thereto). Personnel employed in government establishments or departments included in essential activities elsewhere in this list should be considered according to the activity in which they are engaged.

35. Technical, Scientific, and Management Services.—The supplying of technical, scientific and management services to establishments engaged in war production; union-management negotiation services; publication of technical and scientific books and journals; and the services of Federal Reserve System district banks and branches (does not include services of member banks of the Federal Reserve System).

Book Reviews

HIGH-FREQUENCY INDUCTION HEATING

Application technique is given very lucid treatment in this new reference volume on applied heat. It should prove extremely valuable to both the electrical contractor and the industrial electrical man in selling and applying this type of heat to production processes. All the basic technical application details are given thorough treatment; especially those which deal with the heating of metal parts, such as may be required for hardening, heat-treating, brazing, soldering, annealing, stress-relieving, forging, upsetting, or melting.

The major portion of the text is devoted to the mechanical aspects of induction heating; that is, the design and constructional details of coils for external and internal heating, fixtures for the production setups for brazed and soldered joints, zonal hardening and quenching equipment, multiple heating, use of solenoids and magnets, requirements for annealing, forging, melting, drying, centrifugal casting, and straightening.

Two separate chapters deal with the basic principles and advantages of induction and dielectric heating respectively, covering diagrams of current paths, relation of frequency, heating formula, effect of surface heating, importance of coil design, types of generators, heating plastic preforms and power requirements.

This ready-reference handbook is titled "High-Frequency Induction Heating" by Frank W. Curtis, an authority on the subject and a consulting engineer to the Induction Heating Corporation. The book is published by the McGraw-Hill Book Company, 330 West 42nd St., New York 18, N. Y., and priced at $2.75.

ARC WELDING—ENGINEERING AND PRODUCTION CONTROL

Wide acceptance of the arc-welding process for manufacturing modern structures and equipment and the widespread conversion to arc-welded fabrication are evidence that the process is economically sound in modern industry.

One of the great problems in industry today is to organize and pass on to new key employers a workable knowledge of the shop skill, shop control, and shop know-how which relate arc welding to the fundamentals of modern mass production and scheduling. One of the express purposes of the book is to school these new key employees in modern methods without requiring them to spend years obtaining actual experience to learn all the successive stages in the shop.

No attempt has been made to outline elementary training of operators or to give an elementary description of the welding process since much valuable information is already available on these subjects. The major emphasis has been placed on the general factors involved in arc-welded production and the specific means for their control in a representative fabricating industry. By analysis of these general factors in great detail, the author expects the reader to be able to recognize those most important factors, as reflected in any ordinary industrial situation, and interpret them in the light of his own particular needs.

The book is "Arc Welding—Engineering and Production Control", by Walter J. Brooking, Director of Testing and Research, R. G. Le Tourneau, Inc. It is published by the McGraw-Hill Book Company, Inc., 330 West 42nd St., New York 18, N. Y., and is priced at $4.00.

BASICS OF SUPERVISION

Attitudes, abilities, knowledge and action are the basic tools of industrial supervision and the author of a new text on this subject has broken down the vastly complex structure of supervision, identified these separate basic factors, and arranged in orderly fashion the chain of elements connecting foremanship with safe and efficient production.

The practicing supervisor or production executive needs but to reflect upon his own individual training to agree with the author who states in his foreword, "Foremen, upon whom the nation depends to carry on one of its most important industrial functions, are largely untrained in the art of supervision. Dependence is placed on their individual experience and ability to practice a most difficult art, namely, that of controlling the safe and proper performance of persons, the safe and proper care, maintenance and operation of equipment, and the functioning of the processes, procedures and services of which they are in charge."

Each of the four cardinal essentials of supervision, (attitudes, abilities, knowledge and action) is further broken down

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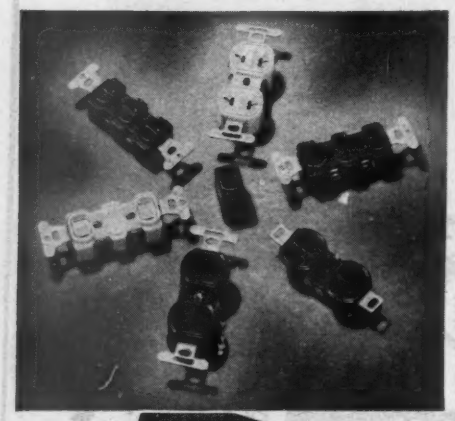

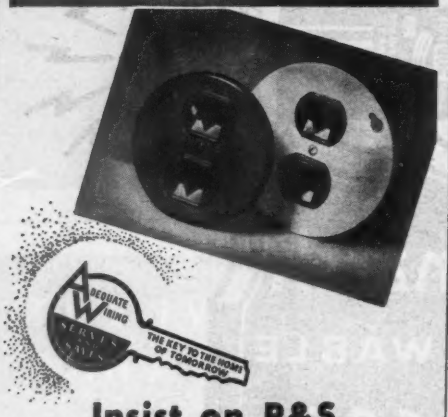

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into four component fundamentals. The resulting entire chain of sixteen basic factors and their relation to one another are explained one by one in simple, concise, narrative style.

Chapters deal with the promotion of efficiency, production and safety; how to give orders; how to maintain discipline; reasons and remedies for unsafe practices; how to check worker performance; how to train foremen; how to analyze people; etc.

The book is "Basics of Supervision", by H. W. Heinrich. It is published by the Safety Engineering Division of Alfred M. Best Company, Inc., 75 Fulton Street, New Work 7, New York, and priced at $3.00.

RESISTENCE WELDING CONTROL COURSE

A training course in resistance welding control has been prepared by Westinghouse and is designed to set forth in a clear and understandable manner how welding processes differ, how electronic control for resistance welding works, and how this method of control extensively adapts this welding process to industry. It is a seven-part training course and includes slide sound films, lesson books, quiz books, and an instructor's manual.

Although produced primarily for Westinghouse employees, the material has been made available to others at reproduction costs because of many requests from engineering groups and individuals interested in resistance welding control.

It is recommended that 8 to 10 hours be allowed for the full seven-part course with two hours allotted for each of the four lessons. Lesson I covers Parts One and Two, Lesson II covers Parts Three, Four and Five. Lesson III covers Part Six, and Lesson IV covers Part Seven and the Quiz. Classes can be held one night each week, thus giving class members a chance for review and supplemental reading.

Subjects covered by the course are as follows:

Part One—Basic Definitions of Welding Technology: forge welding, gas welding, thermit welding, electric arc welding resistance welding.

Part Two—Types of Resistance Welding Work: spot, projection, seam, butt, flash, and duty cycle.

Part Three—The Ignitron and the Thyratron: fundamentals of electronic tubes, ignitron, and thyratron.

Part Four—How the Flow of Resistance Welding Current is Started and Stopped.

Part Five—How the Amount of Resistance Welding Current is Controlled: phase shift heat control.

Part Six—Electronic Timing Controls in Resistance Welding: basic principles of electronic timing, synchronous-precision weld timer, nonsynchronous timer, and sequence-weld timer.

Part Seven—Energy-Storage Control: capacitor-discharge type, and magnetic type.

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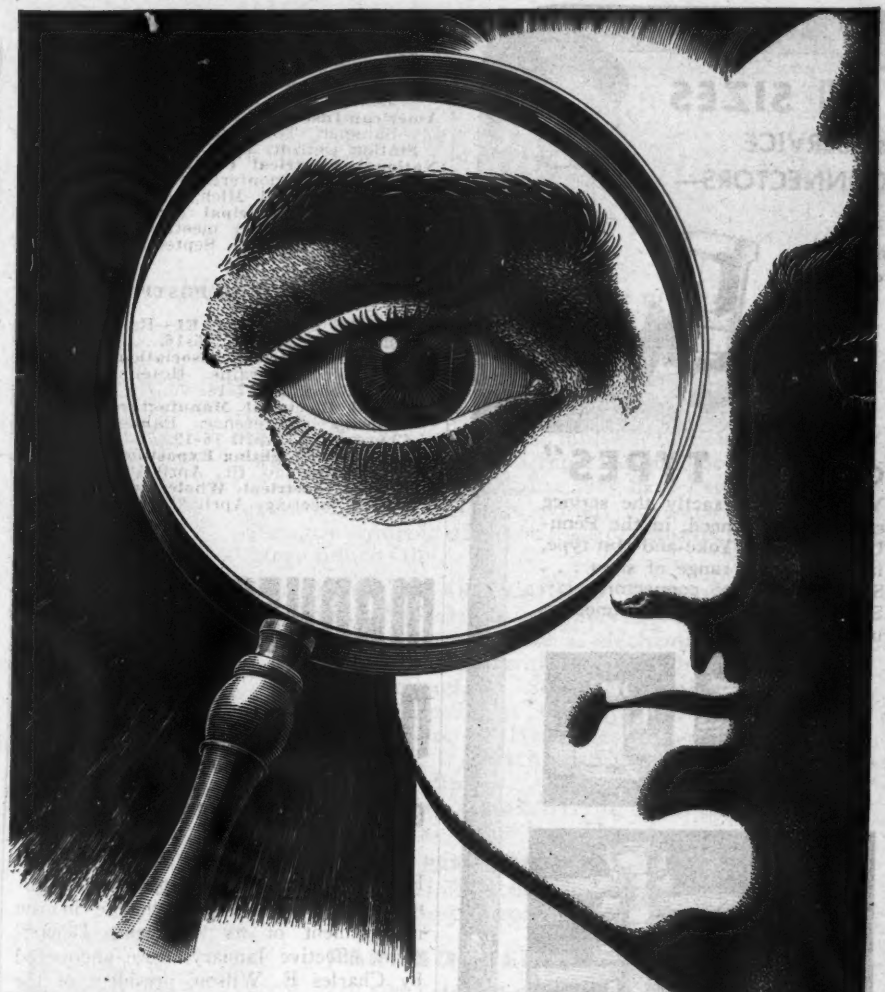
Slide films and records for the seven lessons give clear, visual explanations of the basic theory and applications. (For use with 35 mm. sound slide film equipment). Seven lessons in handy pocket size, reproducing the subject matter of each lesson, are provided each member of the class. These afford a convenient means of review and supplemental study. One quiz book is supplied each member of the class for final review of subjects covered. An instructor's manual giving suggested classroom procedure is provided with complete course. Informative booklets on resistance welding in industry supplement course material.

For a class of 20 a complete set of material costs $50.00 and includes the following: 20 sets of seven lesson booklets and quiz book; 20 sets of supplemental literature; 1 set of seven slide films and records; and 1 instructor's manual. One set of seven lesson books and quiz book is priced at $1.60.

Material for the resistance welding control training course can be obtained from Mr. C. R. Riker, Supervisor, Extension Training, Westinghouse Electric and Manufacturing Company, 306 Fourth Avenue, Room 1712, Pittsburgh, Pennsylvania.

DATES AHEAD

Indiana Chapter IAEI—Antlers Hotel, Indianapolis, Ind., February 1-2.
Industrial Electrical Exposition—Electrical Maintenance Engineers of Milwaukee, Public Service Building, Milwaukee, Wis., Feb. 1-3.
Utah Chapter, IAEI—Monthly meeting, Auditorium, Utah Power & Light Co., Salt Lake City, Utah, February 6.
George Washington Chapter IAEI—Monthly meeting, District Building, Washington, D. C., February 12.
Rocky Mountain Chapter, IAEI—Monthly meeting, Rm. 385, City and County Bldg., Denver, Colo., February 13.
National Metal Trades Association—Annual Convention, Hotel Commodore, New York, N. Y., February 26-28.
Utah Chapter, IAEI—Monthly meeting, Auditorium, Utah Power & Light Co., Salt Lake City, Utah, March 6.
George Washington Chapter, IAEI—Monthly meeting, District Building, Washington, D. C., March 12.
Rocky Mountain Chapter IAEI—Monthly meeting, Rm. 385, City and County Bldg., Denver, Colo., March 13.
Chicago Technical Societies Council—Third Annual War Production Conference, Hotel Stevens, Chicago, Ill., March 29.
Utah Chapter, IAEI—Monthly meeting, Auditorium, Utah Power & Light Co., Salt Lake City, Utah, April 3.
George Washington Chapter, IAEI—Monthly meeting, District Building, Washington, D. C., April 9.
Midwest Power Conference — Palmer House, Chicago, Ill., April 9-10.
Rocky Mountain Chapter, IAEI—Monthly meeting, Rm. 385, City and County Building, Denver, Colo., April 10.
National Industrial Service Association—Annual conference, LaSalle Hotel, Chicago, April 16-18.
National Fire Protection Association—Annual meeting, Palmer House, Chicago, Ill., May 7-11.
Rocky Mountain Chapter, IAEI—Monthly meeting, Rm. 385, City and County Building, Denver, Colo., May 8.
Electrical Committee, N.F.P.A.—Edgewater Beach Hotel, Chicago, Ill., Week of May 14.
Utah Chapter, IAEI—Monthly meeting, Auditorium, Utah Power & Light Co., Salt Lake City, Utah, June 5.
George Washington Chapter, IAEI—Monthly meeting, District Building, Washington, D. C., June 11.
Rocky Mountain Chapter, IAEI—Monthly meeting, Rm. 385, City and County Building, Denver, Colo., June 12.



Take a LESSON from the PUPIL

The eye itself can tell you some interesting facts about the importance of illumination.

When light is inadequate, the pupil automatically expands to allow more light to enter—trying hard for a clear image. But there is a limit to how far it can expand, and if the delicate eye muscles must remain tense to make up for poor illumination, the result is eyestrain, nervousness, and lowered worker efficiency. . . . In properly planned lighting, the quality and intensity of illumination varies with the job's specific requirements for seeing. But always, illumination is adequate to prevent eye fatigue.

Goodrich engineers are specialists in *planned lighting*. With hundreds of styles and sizes of reflectors at their disposal, they are ready to help you insure proper illumination for every industrial task.

Sold through electrical wholesalers.

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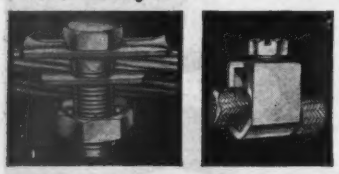
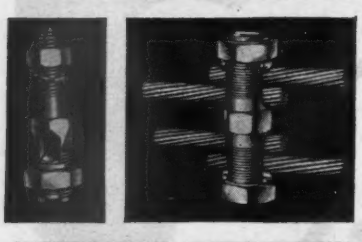
"All SIZES of SERVICE CONNECTORS—

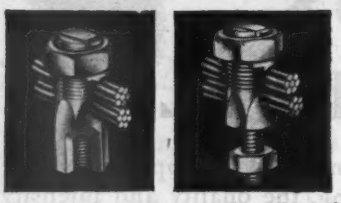
from No. 10 to 1,000,000

and All TYPES"

You can find exactly the service connector you need, in the Penn-Union Catalog: Yoke-and-Nut type, in a complete range of sizes . . . Service Entrance connectors . . . Service Post and Special connectors in wide variety.







Also . . . the most complete line of Tee Connectors, Cable Taps . . . Straight, Parallel, Elbow and Cross Connectors . . . Bus Supports, Clamps, Spacers . . . Grounding Clamps, Terminal Lugs . . . practically every good type.

Leading utilities, industrials, electrical manufacturers and contractors have found that *"Penn-Union" on a fitting is their best guarantee of Dependability.* Write for the Penn-Union Catalog.

PENN-UNION ELECTRIC CORPORATION
ERIE, PA. *Sold by Leading Jobbers*

PENN-UNION
Conductor Fittings

Utah Chapter, IAEI—Monthly meeting, Auditorium, Utah Power & Light Co., Salt Lake City, Utah, May 1.
George Washington Chapter, IAEI—Monthly meeting, District Building, Washington, D. C., May 14.
American Institute of Electrical Engineers—Summer Technical Meeting, Hotel Statler, Detroit, Mich., June 25-29.
National Electrical Contractors Association—Annual conference, Grand Hotel, Mackinac Island, Mich., Sept. 9-15.
International Municipal Signal Association, Inc.—Annual meeting, Hotel La Salle, Chicago, Ill. September 24-27.

CANCELLED OR POSTPONED

Wisconsin Chapter, IAEI—Raulf Hotel, Oshkosh, Wis., Feb. 15-16.
Wisconsin Electrical Association—Annual conference, Loraine Hotel, Madison Wis., February 17-18.
National Electrical Manufacturers Assn.—Spring Conference, Palmer House, Chicago, Ill., April 16-19.
International Lighting Exposition—Palmer House, Chicago, Ill., April 19-23.
National Electrical Wholesalers Assn.—Spring meeting, April 23-25.

MANUFACTURERS NEWS

G-E APPOINTMENTS

Shifts in responsibility for the General Electric Company's employee and commercial relations and a change in the management of its Apparatus Department, effective January, were announced by Charles E. Wilson, president of the company.

E. D. Spicer, formerly the vice president responsible for apparatus manufacturing, is now a member of the president's staff with headquarters in New York. He is in charge of employee relations and is also consultant on general manufacturing matters. William R. Burrows, a vice president and chairman of the labor relations committee retired December 31.

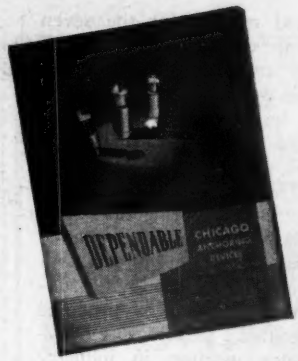
General Electric's apparatus operating committee was discontinued at the close of the year, and Roy C. Muir, formerly a vice president of the executive staff, has relinquished his special duties to become general manager of the Apparatus Department.

Earl O. Shreve, vice president and chairman of the apparatus operating committee with responsibility for all apparatus sales, has relinquished these duties to become a member of the president's staff in charge of customer relations. His headquarters will be in New York.

David C. Prince, vice president, will take charge of the company's General Engineering Laboratory, the activities of which will be broadened to include the requirements of the entire company. Mr. Prince has also been chairman of the company's special planning committee.

Dr. C. G. Suits, assistant to the director of the research laboratory, has been elected a vice president and will be in charge of the Company's research laboratory. He succeeds Dr. W. D. Coolidge, vice president and director of the research laboratory, who retired on December 31.

R. C. Muir, vice president and general



FREE!

NEW HELPFUL GUIDE TO ANCHORING DEVICES

New book presents complete "know-how" story on all types of expansion anchoring devices. Fully illustrated. Complete installation instructions. Handy reference on styles and sizes for every anchoring need. Yours without cost or obligation.

Write for your copy today and complete facts on this dependable line.

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HEAVY DUTY Carbon Lamps

FOR INDUSTRIAL USE

• Recommended for use where *Long Life* is essential, where *Vibration* is excessive, where *Inaccessibility* of lighting fixtures makes *Replacement Difficult*, where a *Pilot Light* is needed.

Available in a wide variety of sizes, shapes, candle power and voltages—standard and candelabra bases.

A large supply of all standard types are carried in stock, thus assuring you prompt service at all times. Write for catalog sheet 1-2 for full details or see your Electrical Wholesaler.

NALCO

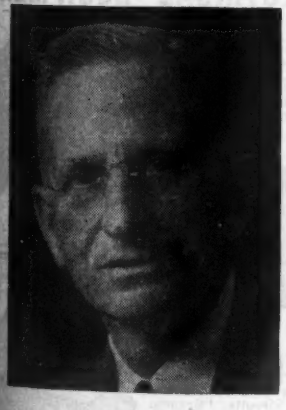
NORTH AMERICAN ELECTRIC LAMP CO.
1044 Tyler Street St. Louis 6, Missouri

manager of the Apparatus Department, has announced several changes in the organization effective January 1.

H. V. Erben, commercial vice president and manager of the Central Station Division, has been named assistant general manager of the Apparatus Department; C. H. Lang, vice president, is manager of sales; H. A. Winne, vice president, is manager of engineering; Neil Currie, Jr.

H. V. ERBEN

C. H. LANG

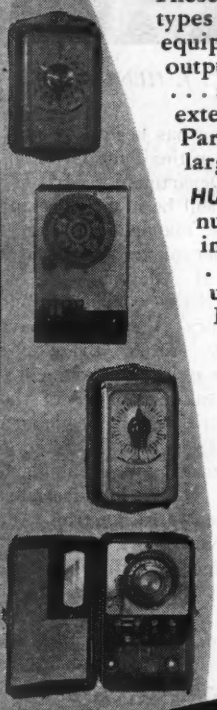


E. J. WEHRLE

is manager of manufacturing; Guy S. Hyatt is assistant comptroller.

Four new appointments in the Meter and Instrument Division were recently announced by E. H. Howell, division manager. They are: Richard Cutts, Jr., manager sales, Meter Section; E. J. Wehrle, manager sales, and R. H. Mitchell, assistant manager sales, Electric Instrument Section; and E. J. Boland, manager sales, Aircraft Instrument Section. The four men will be located at the West Lynn Works.

IT'S TIME TO INVESTIGATE TIMERS



WHEN PLANNING your future stocks or installation work, get full information about Paragon Automatic Time Controls . . . because they offer possibilities for handsome profits. These instruments are used in plants of all types and are built into numerous kinds of equipment. They save time . . . multiply human output . . . reduce errors . . . increase efficiency . . . and lower costs. Because they have been extensively used and are widely advertised, Paragon controls offer you the opportunity of large future sales.

HUNDREDS OF APPLICATIONS—Some of the numerous applications of timers are: Protecting component parts, such as electronic tubes . . . Automatically turning air conditioning units on and off . . . Sequence Timing . . . Laboratory Testing . . . Conveyor Control . . . Light Exposure . . . Heat Treating . . . Pump Operation . . . Machinery Operation . . . Plastic Molding . . . Time delay on pump back spin . . . Controlling pre-heating schedules.

CALL THE PARAGON REPRESENTATIVE . . . for assistance in selection and correct application of Paragon controls.

PARAGON ELECTRIC COMPANY

710 Old Colony Building • Chicago 5, Illinois

Paragon Chicago

BUILDERS OF ELECTRICAL EQUIPMENT SINCE 1905

FASTEN IT
★ RIGHT ★
THE FIRST TIME

with PAINE PRODUCTS

DRILL BITS

"Sudden Depth" Carboloy Tipped Drill Bits cut masonry and concrete 50 to 75% faster, prevent fractured walls, floors and ceilings and assure clean, round, accurately sized anchor, pipe and conduit holes. Can be used in any rotary drill (slow speed). Available in sizes 3/16" through 1¼" diams. (graduated in 1/16" sizes).

Star Drill Bits are forged from the finest tool steel to assure long, satisfactory performance. Standard tool for making expansion anchor holes in masonry and concrete, stone, marble, etc. Furnished in 4 point sizes.

375

365

WOODSCREW ANCHORS

Lead and Fiber Types
The cheapest and best Anchoring Device available for fastenings in Tile, Marble, Concrete, Slate, Wood and Wood Furring.

Easy to obtain, easy to use. You simply place anchor in hole, insert woodscrew and tighten. No setting tool is needed and hole need not be plumb. Both lead and fiber types expand uniformly as screw is tightened assuring a firm fastening and a workmanlike job. Available on low priority in wide variety of sizes.

955

950

TOGGLE BOLTS

Paine Spring Wing Toggle Bolts provide stronger, safer fastenings in hollow material. Easily and quickly installed, they assure permanent support. Available in several head styles in standard bolt diameters from 1/8" to ½" in standard lengths.

Special Toggle Bolt Clamp —free with every box of Paine Toggle Bolts—cuts installation time in half and protects the fingers.

123

Ask your Supplier or Write for Catalog
THE PAINE CO., 2961 Carroll Ave., Chicago, Ill.
Offices in Principal Cities

★ PAINE ★
FASTENING and HANGING DEVICES

C. J. HENDON

C. J. Hendon has been appointed manager of Sales in the Tube Division of the Electronics Department. Mr. Hendon's headquarters will be in Schenectady. He formerly was manager of the Southeastern District of the department with headquarters at Atlanta.

Four new district managers for the G-E Electronics Department have been announced by A. A. Brandt, general sales manager of the Department. They are R. L. Hanks, manager of the New England District with headquarters at Boston; T. B. Jacocks, manager of the Atlantic District with headquarters at Philadelphia; H. J. Mandernach, manager of the New York District with headquarters in New York City; and R. J. Meigs, manager of the West Central District with headquarters in Kansas City, Mo.

L. D. Fowler, Oakland, Calif., has been appointed assistant manager sales of the Integral-horsepower Alternating Current Motor Section. Mr. Fowler will remain at the Oakland Works, where he will be in charge of the General Office commercial activities in connection with the manufacture of electric motors there.

F. H. Craton has been appointed assistant manager of the Transportation Division. For the present, Mr. Craton will also continue his duties as manager of the industrial haulage division.

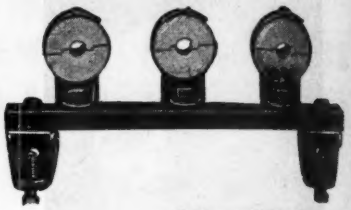
General Electric Company has purchased the radio tube manufacturing and plant facilities of the Ken-Rad Tube and Lamp Corporation at Owensboro, Ky, and at Huntington and Rock Port, Ind., and will take over operation of government-owned plants at Tell City, Ind. and Bowling Green, Ky, where Ken-Rad has been making tubes for the government.

BENJAMIN ELECTRIC CHANGES

L. J. Vavrinek has been named chief engineer of the Benjamin Electric Mfg. Company to succeed P. D. Phillips who will serve as engineering consultant until his retirement next March. Mr. Vavrinek will be in charge of all operations of the engineering and product development activities of the company.

A. E. Swedenborg, who has been field engineer in the Michigan territory with

NEW!
Non-Inductive Conductor Racks



Racks available for any number of cables—cable sizes 5/16" to 2¾".

● Available in types for any number of cables, the M & W Type S-L Conductor Rack is designed so that cables are only partially surrounded by metal. This prevents induced current—permits the rack to be used for A.C. or D.C. systems. Simple design makes for quick, easy mounting of cables.

Write today for Bulletin C-S-51 . . . contains full information on M & W Non-Inductive Cable and Conductor Racks.

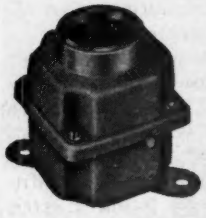
M. & W.
ELECTRIC MFG. CO.
EAST PALESTINE OHIO

THE AUSTIN LINE
MARINE
ELECTRICAL EQUIPMENT

Combination Switch and Receptacle Boxes —W. T. and N. W. T. —double pole, single throw-switch, and single-phase receptacle.

Single, Double, and Triple Receptacle Boxes—W. T. and N. W. T.—single phase.

Branch Boxes—W. T. and N. W. T.—have no fuses and are used to connect branch circuits. Branch Junction Boxes are fuseable.



AUSTIN Marine Products, some of which are shown here, are made to the highest engineering standards carefully inspected and packed, and fully approved by the U. S. Navy. Send for Marine Catalog No. 9-S-2 for complete details on the AUSTIN line.

Lamp Type Indicator Boxes — Watertight. Furnished complete with clear green, red, blue, yellow and opal lens.

THE M. B. AUSTIN COMPANY
108-116 S. DESPLAINES ST., CHICAGO

headquarters in Detroit since December, 1930, has now been moved to the Chicago office. He will contact industrial plants, architects and consulting engineers.

C. H. Pollack, who has been field engineer in New York City since July 1940, has been placed in charge of the Buffalo territory.

R. J. Mors, who has been in the Manufacturing and Service Department of the factory in Des Plaines since 1936, has recently been appointed field engineer working out of the Chicago office.

WESTINGHOUSE CHANGES

Elliott R. Vinson of Alameda, Calif., former electronics technician at the U. S. Naval Air Station, Alameda, has been appointed electronic tube specialist for the Pacific Coast District, Westinghouse Electric and Manufacturing Company. His headquarters will be in San Francisco.

Miss Beryle Priest, formerly home lighting adviser for the Consumer's Power Company of Lansing, Michigan, has joined the illuminating engineering department of the Westinghouse Lamp Division, Bloomfield. Miss Priest will assist Miss Myrtle Fahsbender, director of residential lighting, in developing and designing improved methods of home lighting.

The headquarters of the Radio Receiver Division, located in Baltimore since establishment of the Division six months ago, will be transferred to their permanent location at Sunbury, Pa., in the near future.

GRAYBAR APPOINTMENTS

On February 1, J. P. Lawton took over the duties of Graybar District Commercial Manager in the company's Northwestern District with headquarters in Seattle. He succeeds J. H. Kelly who is retiring on a pension after 30 years of service. Mr. Lawton will have jurisdiction over commercial activities in all Graybar locations throughout the district, which includes offices and warehouses in Portland, Spokane and Tacoma as well as Seattle.

L. C. Esthus was recently appointed manager in Des Moines. He replaces J. P. Lawton.

R. D. Hyneman has taken over the duties of Graybar manager in Portland, Oregon. He succeeds S. G. Ward, who is retiring from the company on a pension after more than 40 years of service.

WESTINGHOUSE SUPPLY APPOINTMENTS

Charles R. Matthews has been named manager of the Northern California District of the Westinghouse Electric Supply Company, with headquarters in San

CANNON CONNECTORS—*in the most amazing places!*

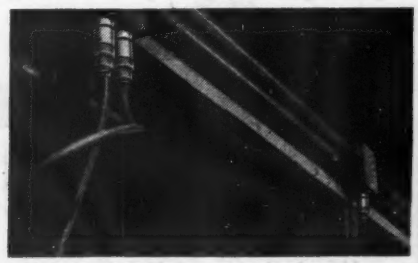
The Rockettes, world-famed precision dancers of Radio City Music Hall.

They tap out precision through

CANNON CONNECTORS

The high fidelity sound system of Radio City Music Hall—the world's largest theater, is connected, throughout, with Cannon Connectors. Cannon Plugs were selected for the job because they could be depended upon. They fit with precision, hold tight and are designed especially for the job expected of them.

You can say that about all Cannon Connectors. The same connector precision demanded in aircraft instruments, in radio and television circuits, in technical laboratory circuits, can be had in the circuits you use. Just specify Cannon Plugs.



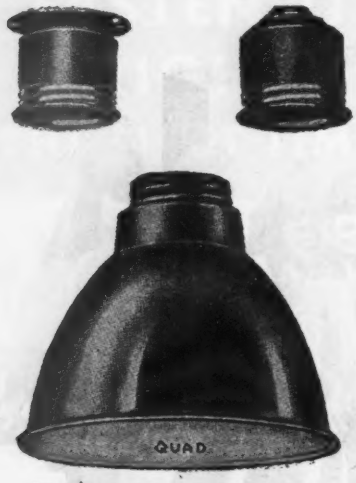
Above: Some of the various Cannon Connectors used in the Radio City Music Hall circuits. If you're interested in this type of connector write for P & O Bulletin.

CANNON ELECTRIC

Cannon Electric Development Company, Los Angeles 31, Calif.

Canadian Factory and Engineering Office: Cannon Electric Co., Ltd., Toronto, Canada

REPRESENTATIVES IN PRINCIPAL CITIES—CONSULT YOUR LOCAL TELEPHONE BOOK



RLM Heavy Threaded Deep Bowl Reflector and Socket Hoods

RLM Threaded Dome Reflector

QUAD LIGHTING UNITS

• QUAD Units have proved themselves in long-time service. Contractors enthusiastically endorse them because they live up to their claims—they give good lighting efficiency for long periods and require little attention. Install QUADS for industrial or commercial installations — indoor or outdoor. Good business is the result. QUAD . . . for today and for tomorrow.

Manufacturers of Incandescent Lighting Equipment

QUADRANGLE MFG. COMPANY

32 S. PEORIA ST.

CHICAGO 7 ILLINOIS

Francisco. Mr. Matthews succeeds E. J. Duggan, who has resigned.

Purchase of the Pixley Electric Supply Company, 226 North Fourth Street, Columbus, Ohio, by the Westinghouse Electric Supply Company was announced recently by David M. Salsbury, vice president and general manager. The Columbus concern, a wholsesale distributor of electrical products, has been made the headquarters for a new WESCO territory, designated the West Central district. L. A. Pixley, who formerly was president of the Pixley Electric Supply Company is manager of the new district, which also covers Cincinnati and Evansville, Ind.

ALLIS-CHALMERS CHANGES

Archibald J. Cooper has been appointed manager of the Allis-Chalmers Manufacturing Company's New York district office. Mr. Cooper, formerly assistant manager of the New York office, succeeds A. F. Rolf, who now will devote full time to his duties as assistant secretary of the company.

Paul Dietz, export sales manager for the General Machinery Division of Allis-Chalmers, Milwaukee, has announced the appointment of Jay C. Warner to assist in the development of the company's sales in the Far East, Australia and New Zealand.

SYLVANIA APPOINTMENTS

Stuart Goodwillie has been appointed manager of the Central Station Sales in the Lighting Division of Sylvania Electric Products, Inc. For the last two and a half years Mr. Goodwillie has been in charge of organization development for Sylvania.

Cortland T. Clark of Seattle, Washington, has been named manager of the Northwestern Division of the Radio Tube Division. His territory will cover the states of Washington, Oregon, Montana and Northern Idaho.

J. T. Millican has been appointed to the sales force, East Central territory of the Radio Tube Division.

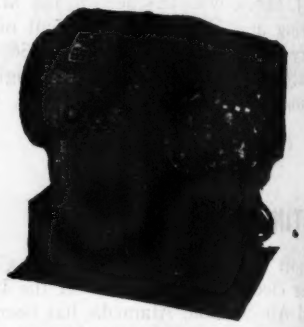
NEW OWNERSHIP FOR AEROVOX

Although ownership has changed hands and a new management has taken over, there will be no changes in personnel nor in policies of the Aerovox Corporation, according to W. Myron Owen, who has just taken over the presidency. Furthermore, the purchase of the stock is entirely for the private investment of Mr. Owen and a few associates. No other company in the capacitor or electrical industry is involved in the change of ownership.

Mr. Owen recently resigned the vice presidency of the Detroit Harvester Com-

110-Volts A. C. from Direct Current

with KATOLIGHT ROTARY KONVERTERS Change 32, 110 or 220 volts D.C. to standard 110-volt, 60-cycle A.C. for operating radios, electronic & sound apparatus, electric signs, A.C. appliances, etc.



KATO ROTARY KONVERTER, 225 Watts

Pioneers in the Building of Small Rotary Converters

At present Kato's entire production must be directed to furnishing converters on priority orders.

Also manufacturers of A.C. and D.C. generators ranging from 350 watts through 25 K.W.; power plants; Frequency Changers; and Motor Generator Sets.

KATO ENGINEERING CO.

639 N. Front St., Mankato, Minnesota

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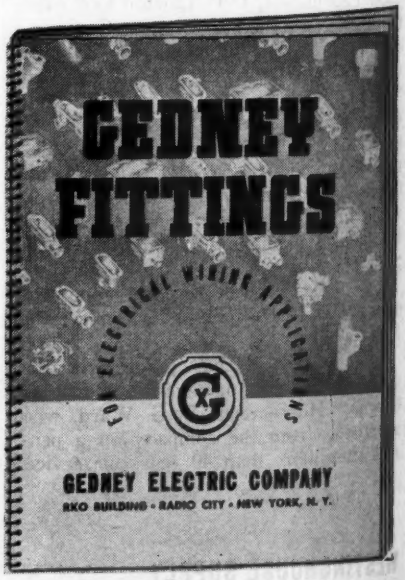
GEDNEY FITTINGS



"Gedney Fittings Fit"

SOLD THROUGH WHOLESALERS

GEDNEY ELECTRIC COMPANY

RKO BUILDING NEW YORK 20, N. Y.

pany, of which he remains a director, to take over the Aerovox presidency.

Associated with Mr. Owen is Stanley Green who is now vice president and chief engineer of Aerovox. For the past 15 years he has served as vice president and chief engineer of the Duncan Electric Mfg. Co. and remains a director of that company.

Samuel I. Cole, retiring president, has been with the company since its start in 1923. He remains as general manager. Samuel Siege, who was vice president, remains with the company as Director of Purchases.

•

Faraday Electric Corporation, Adrian, Mich., announces the purchase of the signal systems business of the Holtzer-Cabot Electric Company of Boston, Mass., effective December 31, 1944.

Holtzer-Cabot operations will continue in the Boston plants through January and February, after which they will be transferred to the Faraday plants in Adrian and Chicago.

•

R-B-M Manufacturing Company, Division of the Essex Wire Corporation, of Logansport, Ind., has announced the appointment of H. L. Huntsinger as sales manager. Mr. Huntsinger was formerly assistant to the sales manager of the Square D Company at Milwaukee.

•

Thomas & Betts Company, Inc., Elizabeth, N. J., announces the appointment of Karl G. Kempf, Los Angeles, Calif., as Pacific Coast manager and H. C. Moses, Jr., Chicago, as middle western manager. Mr. Kempf has been Los Angeles district manager and Mr. Moses was formerly Cleveland district manager.

•

The Trumbull Electric Mfg. Co. of Plainville, Conn., announces the appointment of Leonard S. Poffinbarger as a field representative in the Chicago district. He has had a great deal of experience in the electrical field as a City Electrical Inspector and as a construction and designing engineer.

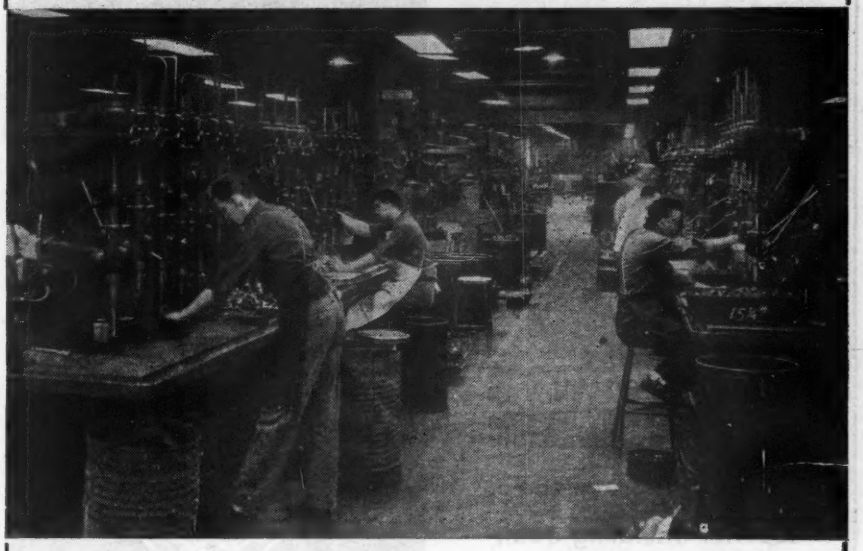
•

The Warren Lamp Company of Warren, Pa., has changed its name to Solar Electric Corporation. The officers remain unchanged.

•

Sheldon Service Company of New York, has announced the appointment of Edgar Hubert as New England Sales Manager, with offices in the Statler Building, Boston. Mr. Hubert was formerly with J. J. Costello Company of Boston.

THE REFLECTOR IS THE BACKBONE OF ANY LIGHTING SYSTEM . . .



Light lifts the Shadow from Plant Morale!

Better lighting of the Wheeler type . . . *Skilled Lighting* . . . means higher morale through reduced eyestrain and fatigue. When you raise morale with Skilled Lighting . . . backed by Wheeler's advanced engineering . . . you automatically get better production too!

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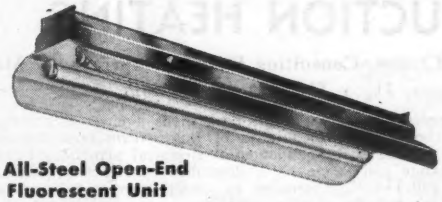

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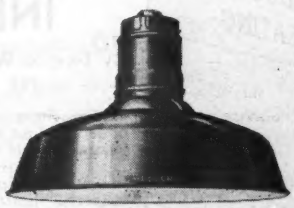

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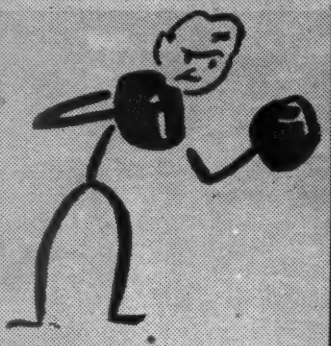

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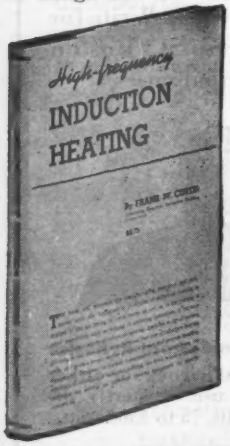

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Contents

1. Principles of Induction Heating
2. Types of Induction-Heating Equipment
3. Design of Induction-Heating Coils
4. Brazing, Soldering, and Joining
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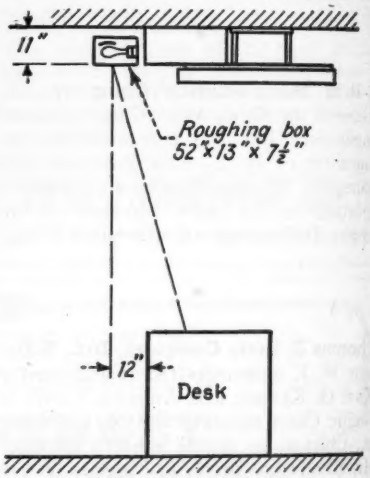
Modern Lighting

[FROM PAGE 94]

ered bottom, fluorescent fixtures—each containing four, 40-watt, 3500 degree white lamps—were installed in the 12-ft., 4-in. by 12-ft., 6-in. office. Units were suspended from the ceiling at a 9-ft., 6-in. mounting height and spaced 6-ft. apart (3-ft. from the walls).

But, the illumination intensity on the desk top was not sufficient for all the seeing tasks performed. Lighting engineers of the local utility company took the problem in hand and decided to use a row of incandescent lens-type units mounted in the ceiling above the back edge of the desk.

The special lighting consists of four Holophane No. 1765, 12-inch lens units in a single roughing box approximately 52 inches long, 13 inches wide and 7½ inches deep. Lamps used are of the



Sectional view

SECTIONAL VIEW of desk lighting showing position of concentrating units with respect to desk location; also fluorescent fixture for general lighting purposes. (Figure 2)

200-watt, daylight incandescent type. Focus of the unit is 4½-inches (distance of lamp filament from lens) and lamp offset (distance of lamp filament to right or left of center line of lens) is 2½ inches at 45 degrees.

With this combination, double-range lighting is possible. Ordinary general illumination of 40 foot-candles is provided by the two fluorescent units; supplementary high intensity lighting on the desk top—in the order of 60 foot-candles—is added just by a flip of the switch. Depending upon the severity of the seeing task, the occupant of the desk can have either 40 or 100 ft-c.

The lighting efficiency is boosted by the interior decorating scheme. The ceilings are white acoustic tile and the walls are finished in a light color with the area below the chair-rail finished in a pastel green shade.

Practical Methods

[FROM PAGE 76]

teresting phenomenon, and have worked out a preventive.

Hitherto, one of the most widely used methods of stripping and tinning Formex-insulated wire has required that the wire be dipped into molten solder held at about 1025-110°F.

In this method, laboratory tests show two effects: 1) the wire suffers a reduction in diameter in the stripped and tinned section; 2) some embrittlement of the wire occurs due to the high temperatures encountered.

Although stripping-tinning action may be held through close control to the minimum time required, some copper loss can be expected. Higher temperatures, up to 1175 degrees F., reduces the minimum dipping time, but at the same time it shortens the destruction time. Number 40 H.F., is destroyed practically as the stripping and tinning are completed.

This phenomenon in wire destruction is not alone interesting, it is important and serious. Such reduction in diameter in hot tin dipping means weakened leads, perhaps production losses either at the dipping operation, or later in assembly, and an inferior product that fails in the field.

Three variables were considered:

1) *Wire size*—Three wire sizes, Nos. 29, 34 and 40, were selected as representative of the more commonly used small and fine wires.

2) *Solders*—Three tinning solders, 60 tin/40 lead, 40 tin/60 lead, and 0 tin/100 lead (using pure lead), gave an approximate general working range down to pure lead. This was considered an indicative selection of solders.

Metallurgically speaking, all solders with a melting point below 600-700 degrees F. are defined as "soft" solders. All solders having a melting point of approximately 1100-1200 degrees F. are considered "hard" solders; this includes silver solders. All the tin/lead solders are considered "soft", but 40/60 is often referred to as "soft" solder; 50/50 as "common" solder; 60/40 as "hard" solder. The difference in solder designations, metallurgically, and in the trade, should be borne in mind.

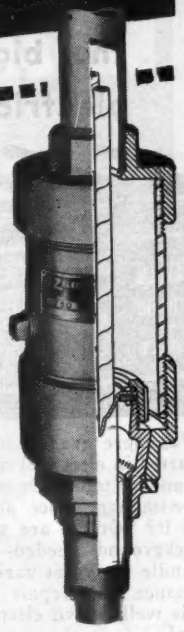
3) *Solder temperature*—For purpose of these tests, temperature ranges of 550 to 1175 degrees F. were selected; 600 degrees F represents the lowest reasonable working temperature practical, just above the melting or liquid points of soft solders.

Tests were made to above 1100 degrees F. and were considered as representing the approximate working range that would be encountered in normal

[Continued on page 180]

GET MULTI-PURPOSE SERVICE
with O. Z. "J" Terminator Potheads

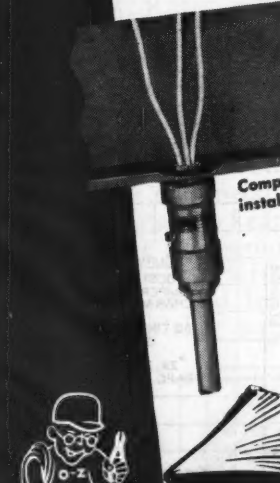
This "J" Terminator, developed by O. Z. incorporates the general principles of O. Z. Terminating Potheads but adds a collapsible feature which makes it easy to install. The collapsible feature also provides a method of tying in conduit with a pothead to the under side of pull boxes, cabinets and transformer secondary boxes. The access chamber provides ample space for pulling in of wire and splicing if desired. This chamber also affords working space for bell-ing and sealing cables on the O. Z. adaptor especially designed for this purpose.



THE O. Z. "J" TERMINATOR is also adaptable for straight through conduit runs.

Disassembled on conduit

When installing with cabinets—the conduit work is terminated at the proper height below the box. The "J" terminator is dismantled and properly assembled on the end of the conduit, then tied into the box with a chase nipple furnished with the fitting. When wiring work is underway, the unit can be disassembled again on the conduit, permitting sealing of wires, then reassembled complete, making a mechanical bond between the conduit raceway system and the box.



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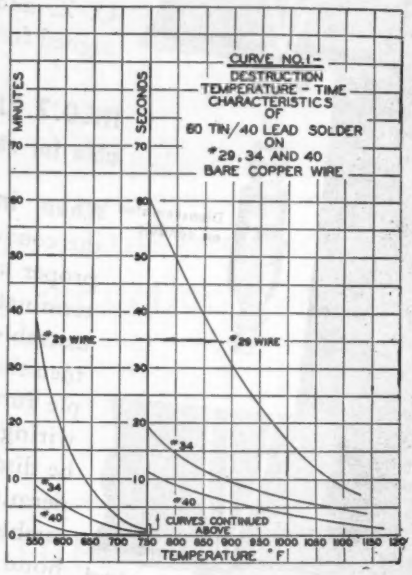
Practical Methods

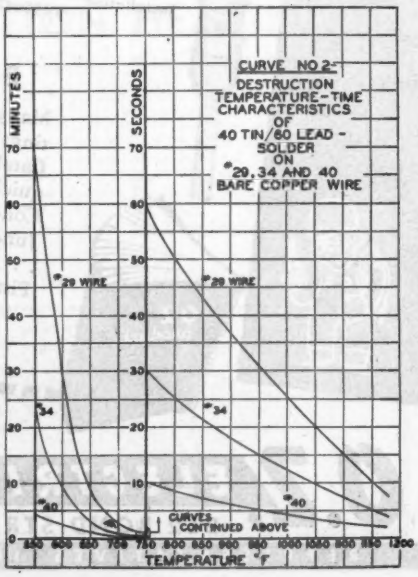
[FROM PAGE 179]

practice for hot-tin-dip stripping of Formex.

Approximately 400 wire samples were tested. All tests have been plotted up in Curves 1, 2 and 3. The curves represent the average values for each test condition. Similar destructive results were observed in using silver solder at a test temperature of about 1275 to 1300 degrees F.

Analyzing curves 1, 2 and 3, it is apparent that the greatest rate of change in destruction time with temperature change occurs in the range of approximately 550 to 750 degrees F., for 60/40 and 40/60 solders, and 650 to 950 degrees F. for pure lead. However, the time required for tin dipping is short, a matter of seconds, compared with the destruction time, especially at the lower temperatures. The nearer to the melting or liquid point of the solder that this tin dipping is performed, the better, be-





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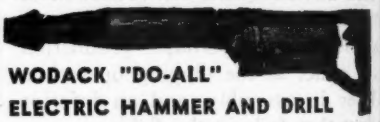

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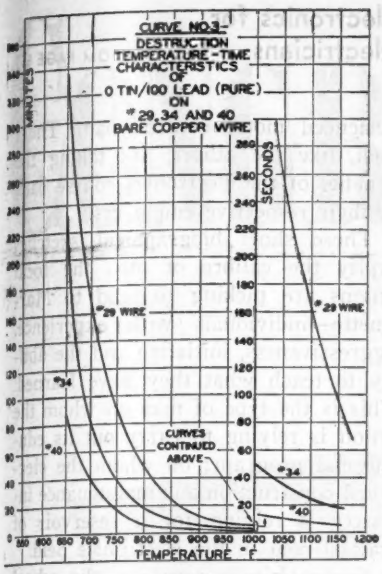

cause the time spread is greater.

All curves clearly demonstrate that temperature increase has an accelerating effect upon the destruction time. One logical conclusion is that if the wire can be stripped by another method not requiring the high temperatures of the strip-tin dip method, lower tinning temperatures can be used and copper destruction thus avoided. And this is actually the method used by Fairchild.

The test data leads to three major conclusions:

1) The life and diameter of any small to fine size copper wire in any solder is decreased with increasing molten solder temperatures.

2) The higher the tin content of tin/lead solder, the shorter is the life of a given wire in that solder for any given solder temperature. Unfortunately, however, an all-lead solder results in a considerably weaker solder joint than tin/lead solders.

3) For a given solder composition and solder temperature, the finer the wire size, the shorter is the wire life in the solder.

The all-around best solder of those tested appears to be the 40/60 combination, commonly referred to as soft solder. Other solders in this vicinity may offer even better properties.

Solder temperatures should be kept, either, within 150 degrees to 200 degrees F. above the melting or liquid point of the solder used, or under 600 degrees F. For Formex coated wires, a low temperature insulation stripping method other than the hot tin dip method now becomes necessary. Other methods, involving high temperatures, such as the gas flame method, tend to introduce wire embrittlement and copper oxidation, and are no better.

In summary, it is important that the fine sizes (Nos. 34-40) of synthetic coated wire be stripped, tinned and joined or soldered at temperatures at or under 600 degrees F.

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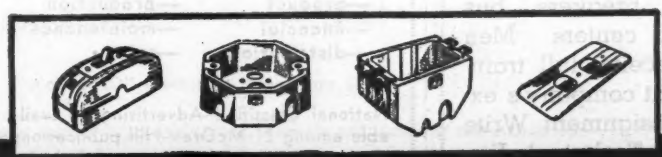

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Electronics for Electricians

[FROM PAGE 55]

perienced motor control man. These men, like the others, are taking the benefits of the electronics course back to their respective employers.

These short biographical sketches typify the calibre of men the local unions are picking to send to Marquette—individuals with experience, aggressiveness, initiative and the ability to teach what they have learned. This is the type of man on whom the union is relying to carry out its educational program; on whom the electrical construction and maintenance industry is relying for a reservoir of trained men in the electronics field.

Geographically speaking, the school is truly national in scope. A line passing through the home towns of some of the first term graduates would virtually encircle the country. They came from the Pacific Coast, Gulf Coast, East Coast, Great Lakes Region and inland states.

The administrative faculty, naturally, experienced some trepidation at the outset. It was a pioneer venture on the part of the union; a new experiment in accelerated adult education on a highly technical subject; a new experience for many of the journeymen students. Perhaps it wouldn't work.

The success of the mechanics of the course was apparent, however, by the end of the first term. It was workable. It fitted the men. It was doing the job. Commenting on the first term, Dean Bliss reports, "The course is exceeding expectations in all respects. We have splendid cooperation from IBEW and the manufacturers. The calibre of the men is high, their intense interest unusual . . . they asked for additional instruction in related subjects and math . . . they asked for continuance of the course into evening hours. IBEW has used good judgment in screening and selecting the men."

Is the IBEW broad plan of electronic education a success? A positive or negative answer at this time would be premature and pure conjecture. The school is successful but that is only the first step. Much depends upon those who return home and the men whom they instruct. Those who leave Marquette will not be electronic engineers —that's expecting the impossible. They will, however, have a sound background in the fundamentals of the subject and—what's equally important—a source knowledge of reference material for future study.

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27 PARK PLACE NEW YORK, N. Y.

Start-up and Shutdown Methods

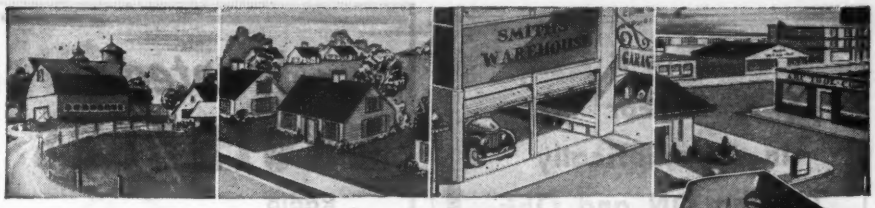
[FROM PAGE 87]

(c) Do not disturb dash pots.
(d) If corrosion conditions are severe; a light application of vaseline on contact surfaces may be advisable.

3. Controllers—drum type.
   (a) Apply oil or grease at normal lubrication points.
   (b) Leave controller in "off" position and cover securely in place.
   (c) Do not grease contact surfaces unless conditions are particularly corrosive, then use light application of vaseline.
   (d) Protect controller from dust accumulation by special wrapping of paper.
4. Pushbuttons.
   (a) If oil immersed, be sure oil is at proper level and that there is no leakage.
   (b) If air-break type, fasten cover securely.
5. Rheostats—field, starting and speed regulating.
   (a) Do not grease contact surfaces unless corrosive conditions are very severe.
   (b) Use special paper covering on starting and speed regulating rheostats to keep excessive dust from resistor tubes.
6. Resistors.
   (a) Touch up damaged spots on frame coating with an aluminum paint.
   (b) Do not apply paint, grease, or other protective coating on any part of the resistor elements or the insulating elements.
   (c) Protect from accumulation of dust by special covering.
   (d) Resistor tubes with vitreous coatings require no special attention.
7. Rectox Rectifiers.
   (a) It is desirable to keep storage temperature below 25 degrees C., to prevent excessive aging. Therefore a space heater should *not* be placed close to a Rectox unit.
   (b) Blow any accumulation of dust from the Rectox assembly to prevent moisture absorption with possible consequent formation of a corrosive coating.
   (c) Oil immersed units need not be disturbed.
8. No-Fuze (AB) Breakers.
   (a) These breakers need no special precautions.

9. Generator voltage regulators.
   (a) See that cases are securely in place and protect from dust by special wrapping of paper.
10. Knife Switches, Disconnect Switches, Fuses.
   (a) Switches may be left in the closed position. Where corrosive conditions may be severe, a protective coating of vaseline should be applied to the entire switch and particularly to the contact surfaces.
   (b) Ordinary cartridge fuses should be left in place, with contact surfaces protected against possible serious corrosion.
   (c) Main line fuses (such as BA) designed for indoor use, may incorporate organic insulation material which may ultimately warp under repeated unfavorable moisture conditions. Aside from protection against such moisture conditions, no further special precautions need be taken. Outdoor fuses usually contain no organic insulating material, but even so their life can be prolonged by storing inside a building.
11. Enclosures.
   (a) Short steel enclosures should have any damage to protective coating touched up.
   (b) Hinges and latching mechanisms should have a light application of oil or grease.
   (c) Sealing surfaces of explosion proof enclosures should have a light application of grease, and cover plates left in place with securing screws or bolts pulled up firmly.
   (d) Oil filled enclosures should be filled to proper level and left securely in normal position, without leaks.
   (e) Gaskets of weatherproof enclosures should be in normal good condition.
12. Wiring, Cables and Conduits.
   (a) Busbars should require no special protection, except in cases where corrosive conditions are expected to be serious. In such a case a light coating of vaseline may be applied. It should be applied carefully to prevent splashing and dripping on other apparatus, and in a way that it can be entirely cleaned away at start-up—to minimize future fire hazard.
   (b) Insulated wire on panels needs no special protection.
   (c) Insulated cables run on insula-

[Continued on page 186]



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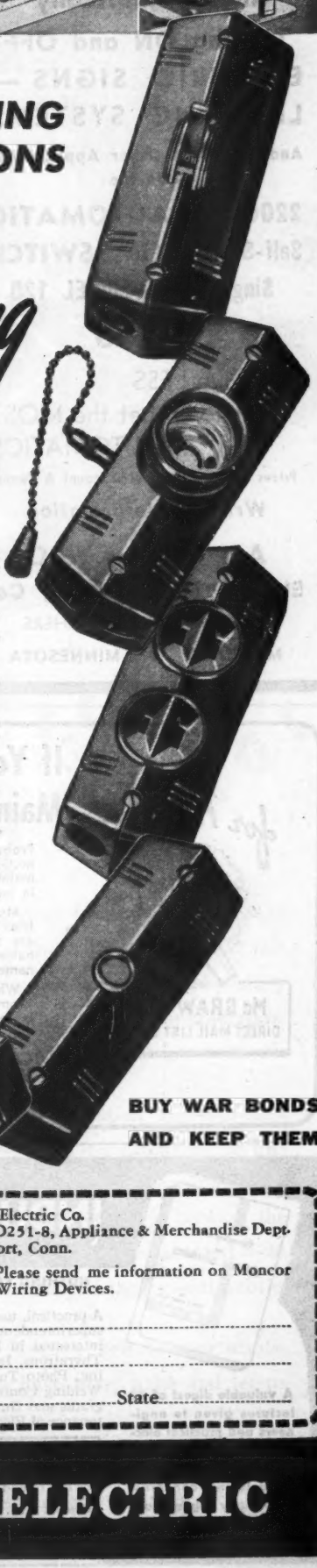

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Start-up and Shut-down Methods

[FROM PAGE 185]

tors in the open should have a coating of an asphalt base paint if preservation of the insulation is important.

(d) Bare or lead covered cable needs no special protection.

(e) Underground conduits, ducts or cable ways should be closed against rodents in a way to permit circulation of air.

13. Terminal Guards.

(a) Multi-circuit control terminal boards should be specially protected against moisture drip or dust accumulation by a special suitable paper covering.

14. Meters, Instruments and Relays.

(a) This type of equipment is inherently designed for long life and trouble free operation with little attention. They are designed to be corrosion resistant, and are frequently inoperative for considerable period. Therefore, only a few simple special precautions need be taken when the plant is shut down.

(b) Remove ink and damping fluid from graphic meters and clean fluid wells, pen, and complete inking system.

(c) See that all covers are pulled up securely.

(d) Wrap each device with a simple close fitting paper covering to minimize infiltration of dust.

Starting-Up Control Apparatus and Switchgear

1. Remove all coverings carefully to prevent dust falling onto apparatus. Clean all apparatus by blowing with dry air stream and by wiping.

2. Remove any protective coatings completely and without contamination to other equipment.

3. Remove excessive grease from mechanical parts and relubricate as required.

4. Check apparatus for free mechanical operation, manually where possible.

5. Renew all insulating oil.

6. Clean all main current-carrying contacts (breakers, contactors, relays, knife switches) of any oxide film or corrosion.

7. Dash pots should require no change of fluid unless the time has been excessive.

8. Blow dust out of resistors, grids, Rectox rectifiers and terminal boards.

9. Operating coils of all types should be dried out and checked with a meg-

ger. They may be dried out by a gradual application of low voltage or current (10 to 25 percent), by use of space heaters within enclosures, or by building heat.

10. All porcelain insulators and similar creepage areas should be effectively cleaned.

11. The time of operation of large oil circuit breakers may require a check.

12. Ducts and cable ways should be blown out and dried out by passing a stream of dry warm air through them.

13. Insulation values to ground should be checked with a megger. This should be done on operating coils, wiring, buses and cables.

Shutting-Down and Starting-Up Mechanical Power Transmitting Apparatus

Gear Units

1. Clean off excessive dust and grease accumulations by use of air blast and wiping.

2. Add 8 to 10 percent (by volume) of a rust inhibitor to the oil in the reservoir. Such an inhibitor does not harm the lubricating qualities of the oil but has a strong affinity for metal. It is automatically removed when the machine is operated and the oil is changed. The machine should be operated for ½ to 1 hour after the rust inhibitor has been added, assuring a coating on bearing and gear tooth surfaces.

3. Overhung belt or chain drives should be slackened or removed.

4. Any grease lubricated bearings should be completely filled with the normal grease.

Couplings

1. Slush or spray coupling with grease or rust resisting compound keeping such coating away from any rubber or similar materials.

2. Oil filled couplings should contain the normal amount of oil.

3. A few drops of penetrating oil should be placed on coupling bolts and key ways.

Belts

1. Rubber or leather belts preferably should be removed and properly stored in a reasonably cool and dry place.

Starting-up

1. Clean off protective coating.

2. Renew oil in gear case and oil filled couplings. Flush gear case.

3. Inspect flexible elements of couplings.

4. Inspect gearing.

5. Rotate slowly, and listen for unusual gear or coupling noises.

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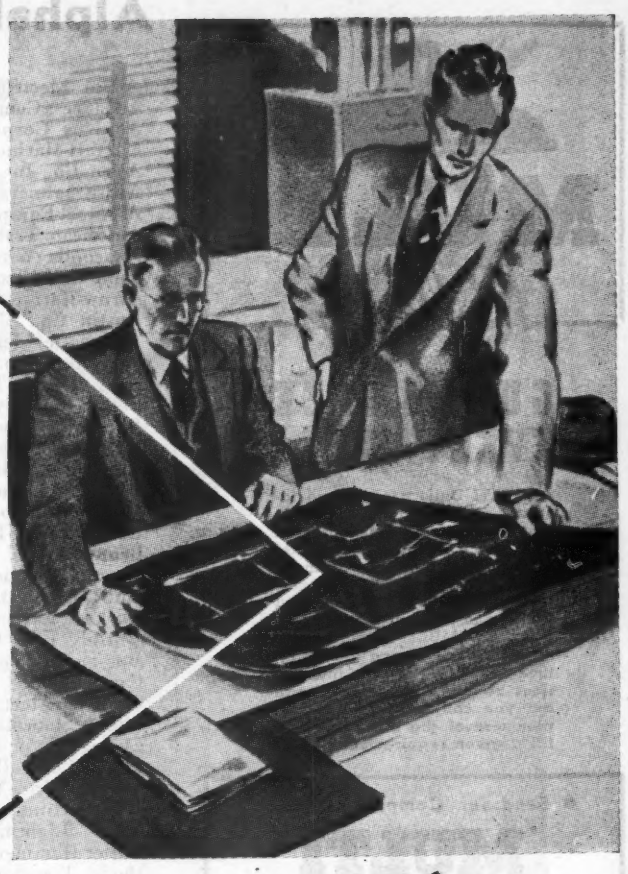

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Wire and Cable Connectors
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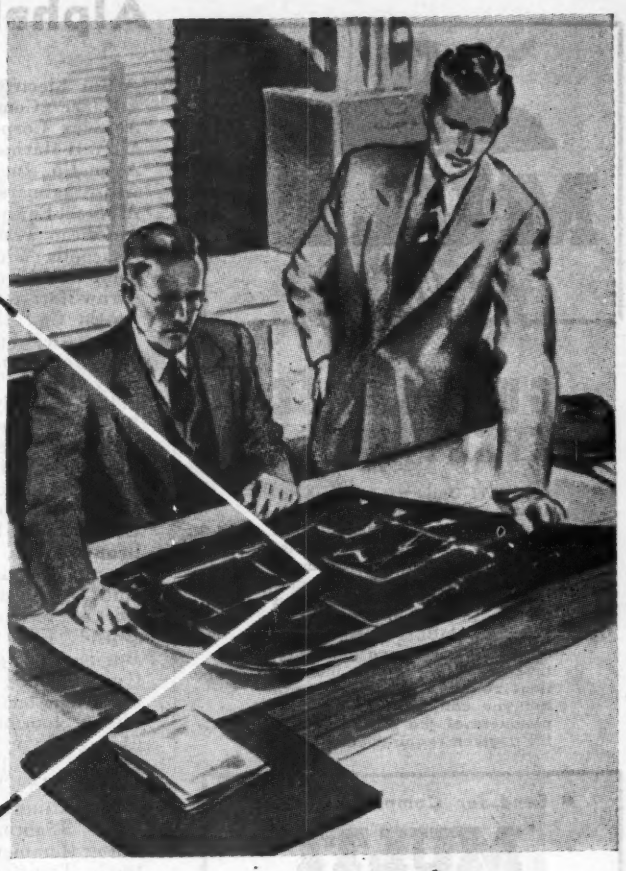

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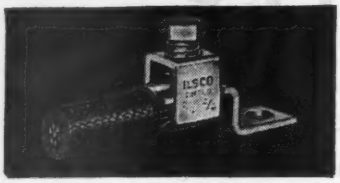

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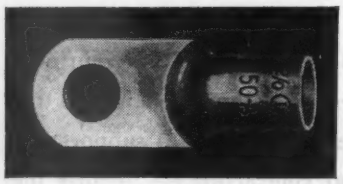

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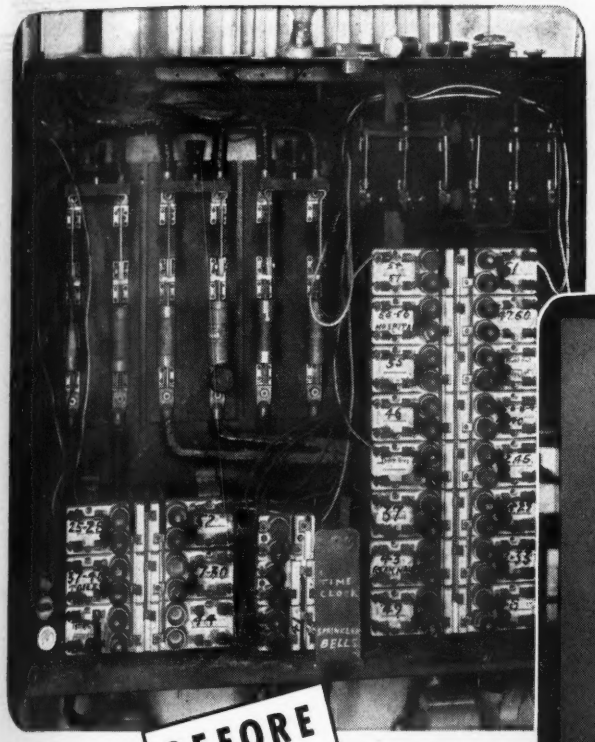
***These companies have included Briefalogs, containing additional buying information on their products, in the 1945 edition of the Electrical Buyers' Reference.**

No Plant Too Large *or too small* To Profit by this SQUARE D *Conversion Plan!*



Contractors, here are facts you can use in developing a lot of worthwhile industrial business. Panelboards, taxed beyond their efficient capacities, are a drain on the productivity of any plant—regardless of size. This speedy Conversion Plan involves such a moderate investment that it "pays off" in a hurry, even in the smallest plant.

The pictures above show a typical conversion. With a minimum of time and labor and at no increase in space, 25 lighting circuits were increased to 42—up 68%. Circuit breaker convenience and protection replaced obsoleted fusible circuits. Notice, too, that Saflex units were installed for the main controls, with sufficient space provided for an additional circuit, if and when it is needed.

Remember, such conversions as these utilize existing boxes and conduit. The cost in time and money is small. The dividends in conserved power and increased efficiency is substantial. Get this story over to your industrial customers and prospects and you'll get results.

Write for a free copy of "MORE CAPACITY" which shows a variety of conversions in detail. Address Square D Company, 6060 Rivard Street, Detroit 11, Michigan.

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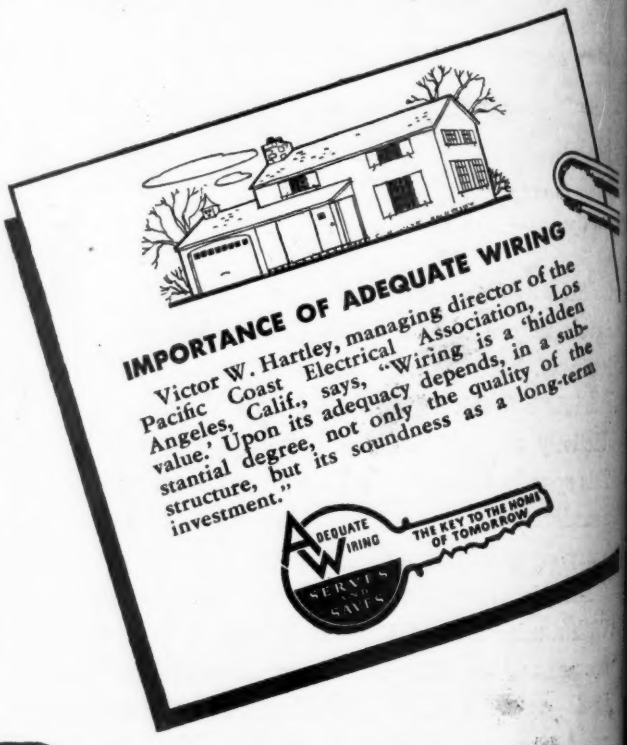
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Victor W. Hartley, managing director of the Pacific Coast Electrical Association, Los Angeles, Calif., says, "Wiring is a 'hidden value.' Upon its adequacy depends, in a substantial degree, not only the quality of the structure, but its soundness as a long-term investment."
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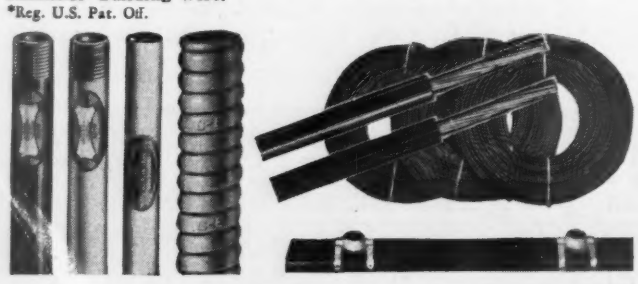

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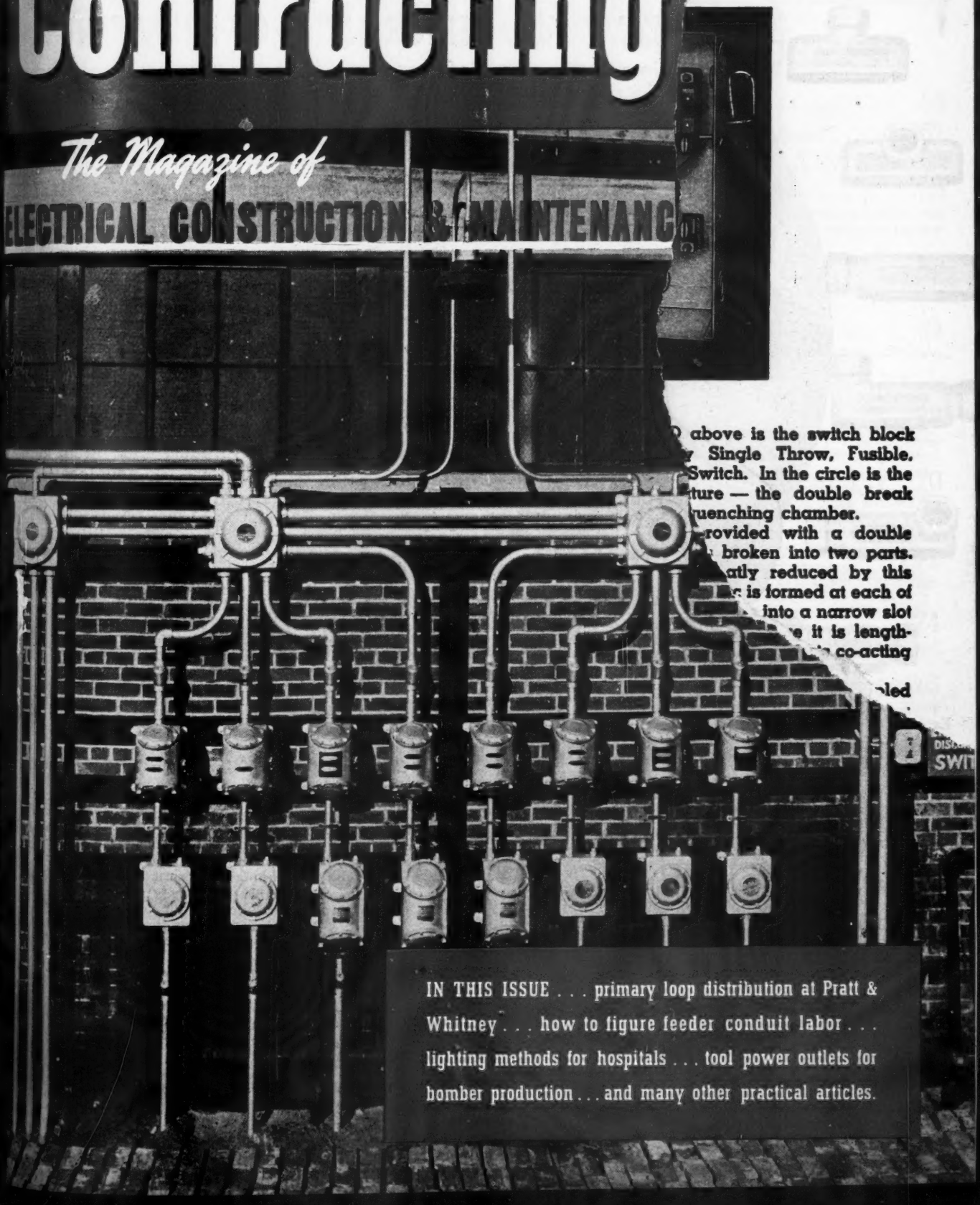

IN THIS ISSUE . . . primary loop distribution at Pratt & Whitney . . . how to figure feeder conduit labor . . . lighting methods for hospitals . . . tool power outlets for bomber production . . . and many other practical articles.